TROPICAL AGRICULTURE

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EMPIRE COTTON.

For many years past, the Cotton Trade in Lancashire in particular and in other parts of the Empire as well, has suffered from violent fluctuations in the price of cotton. The controlling factor at present is the American crop, since the United States of America is by far the largest producer of raw cotton. One has only to look at the production figures for the last twenty years to see how great is the fluctuation from year to year. For the last three years for instance America produced large crops and last year the crop was approximately eighteen million bales. The last Bureau report, however, indicated only 12,678,000 bales and equally large variations have been experienced in the past. It is evident, therefore, that the permanent recovery of the cotton growing industry in America is not yet in sight and it is, therefore, more and more urgent that cotton supplies from other sources should be extended, in order to meet the increasing consumption of this staple. The realisation of this fact, not only by the cotton trade in Lancashire, who have for many years been uneasily aware of the contingency, but also by the Imperial Government, led to the formation of the Empire Cotton Growing Corporation, a body that has now been at work for six years and whose object is to extend cotton growing within the Empire with the object of making it less dependent on outside supplies. It should be mentioned in this connection, that the British Empire is not the only one that has recognised the present dangerous state of affairs. The French and other European nations have realised the possibility of a cotton shortage and are making strenuous efforts to extend production in their respective colonies.

The Empire Cotton Growing Corporation is financed partly by the Imperial Government, who give a lump sum dependent on the application of a levy by the cotton interests in Lancashire, on every bale of cotton coming into the country. This levy was voluntarily agreed to by the majority of the cotton manufacturing firms five years ago and was subject to renewal at the end of that period. A new Bill to authorise a continuation of the levy is about to be introduced into the Houses of Parliament, and comes at a somewhat unfortunate time in that the cotton industry in England has been passing through a period of severe depression during the last few years. It will prove interesting, therefore, to note the results of the Corporation's efforts since that Body came into being six years ago.

So far as production is concerned the output of Empire grown cotton, excluding India, has been more than quadrupled and has expanded from 100,000 to 427,000 bales. This increase is significant in view of the fact that a period of low prices has occurred during this period and seems to indicate that the spade work has been thoroughly done. The general public can naturally not realise the enormous amount of preparatory work that is necessary before a cotton growing industry can be established on a secure basis in a country that has never grown cotton before. Not only has a careful survey of the soils to be made and a study made of climatic conditions, but the local agriculturist has to be taught how to grow cotton and large economic factors which may influence the whole method of living of the inhabitants of a country consequent to the introduction of a new crop such as this on a large scale, have to be taken into account and carefully considered. In the African colonies, where so much promise so far as cotton is concerned lies, the native is often a most primitive cultivator and has only been accustomed to grow food to meet his immediate needs. In such cases it is often necessary to start right at the bottom and teach him the first elements of tillage. Much effort in this direction has been put in and is only just beginning to show results. If a permanent improvement is to be effected, however, these demonstrations will certainly have to be continued for many more years. If the effort is dropped now the native cultivator will probably relapse into his primitive state. A successful start has been made for example, in teaching the cotton grower of Uganda the use of the plough, an implement he had never heard of before cotton came. It will take several more years of practical demonstration before the practice can become an accepted one in this colony, since the local cultivator will have to learn how to train his cattle and to repair his implements. Arrangements for a regular supply of implements and spare parts will have to be arranged for and stocks kept in the stores as a routine matter.

Much of the work of the Corporation has of necessity been exploratory in the past six years. This stage is rapidly passing and largely due to the efforts of the Corporation's officers, the Empire has now a very fair idea of the areas which can grow cotton. It has been established, for instance, that there is a very large area of land in Central Queensland which is capable of growing high class upland cottons. Similarly, a huge area in the southern Sudan has been proved and much exploratory work of this nature has been done in Rhodesia and other colonies.

The investigations of the Corporation have also brought out the singular dearth of trained officers in the Colonial Agricultural Departments. It has been recognised that in order to grow cotton a sound knowledge of agricultural practice is a first essential. It has further been realised, that if cotton growing is to be introduced on a large scale, it will be necessary to study the crop in its relation to the agricultural economics of the country as a whole. In other words, that cotton can be best grown in a system of mixed farming. It is, therefore, necessary to find out which crops can best be grown in rotation with cotton and which of them fit in best with the general economic situation of the country as a whole. Cotton is a crop that is liable to severe damage from insect pests if grown as a pure crop over large contiguous areas. Work in Queensland and in other parts has shown that one of the best ways of combatting the cotton boll worm (*Chloridea obsoleta*) is by practising a system of mixed farming with maize, which is an alternative host plant to this pest, as the other main crop. In some places it has been found necessary to introduce in addition to a food crop, an alternative export crop such as ground-nuts, so that if the price of cotton falls unduly low, the finances of the cultivator will not be unduly upset.

Turning to the research activities of the Corporation a good start has been made, but many of the investigations cannot be productive of applicable result until the work has been carried on over a series of years. Much of it is of a fundamental and "long time" nature, and this is particularly the case with the work of the Cotton Research Station which the Corporation has established in Trinidad. At this centre fundamental research into the genetics and the physiology respectively of the cotton plant are being conducted and the Station has only been at work for rather more than two years. It has been equipped in a most complete manner and staffed with highly qualified officers. Lines of research have been commenced which promise ultimately to be of the greatest value to the cotton grower, but will have to be carried on for a series of years if they are to give results. A wonderful collection of cottons has been collected from all over the world and much technical equipment has been got together. It would be a misfortune of the first magnitude to scientific research if through any mischance it were not found possible to keep this Research Station going.

In other fields of research equally good work is being done and problems directly connected with the economics of cotton growing are being tackled. Great progress has been made in improving the seed supply by the application of scientific methods since it has been found that in every one of the colonies that are attempting to grow cotton for the first time, the problem of first raising and later propagating an improved strain of cotton to suit local conditions is a most vital one. One of many outstanding successes that have been achieved in this direction is the raising of jassid resisting strains to suit South African conditions at the Barberton Cotton Station. If this work can be continued for

a further period it is bound to have important economic results as on its successful outcome depends the whole future of cotton growing in South Africa and Rhodesia.

Finally, there is another branch of its activities for which the Corporation does not always receive its due share of credit. Mention has been made above of the need for trained agriculturists in the Tropics and of the fact that the extension of cotton cultivation is definitely bound up with the raising of the whole standard of agricultural practice in these colonies. The Corporation was the first body to recognise this dearth and to elaborate a system of scholarships which would enable men of the right type from the Universities to complete their training in tropical agriculture. Cotton students have attended the Imperial College of Tropical Agriculture in Trinidad for special training of this nature for the last four years. A similar system has now been adopted by the Colonial Office also and it seems likely that other institutions similarly interested in the development of tropical agriculture may find it necessary to adopt like means of securing the services of trained men.

In conclusion, it is obvious that the Empire Cotton Growing Corporation has reached a definite stage in its developments. Much of the spade work and preliminary exploration has been completed and it is now entering on the stage, when after having been able to elaborate certain definite schemes for furthering its object, which is the extension of cotton growing in the Empire, it requires the necessary funds and opportunity to get them going and bring them to maturity. If the Corporation were to cease at the present time, the greater part of the time, energy and money that has already been expended, will be wasted. If it is allowed to continue and elaborate its schemes, there is every hope that it will play a leading part in making cotton one of the most important economic crops of the Empire.

SUGAR MACHINERY.

IT is pointed out in *Commerce Monthly*, the official organ of the National Bank of Commerce in New York, that the expansion of the world's sugar crop by one-third within the last decade has entailed a large demand for field and factory machinery in connection with this industry. Cane sugar, which now forms two-thirds of the world's entire sugar supply, is grown chiefly in tropical and sub-tropical regions where the steel industry has not been developed to the point of producing modern technical equipment. For this reason there is an extensive southward movement of machinery from northern Europe and from the United States to supply the great agricultural regions in the Tropics. Five countries supply the bulk of the equipment required. These are, in order, the United States, United Kingdom, Netherlands, Germany and France. American and French exports in 1925 showed a notable increase over those of 1913-14, while German exports are still considerably below the pre-war volume. For the United Kingdom and the Netheralnds no comparison can be made, as the exports of machinery for the sugar industry were not separately reported in the pre-war period. The beet sugar industry is developed in a number of European countries, which are in general able to supply their own factory installations. There is, however, some movement for beet sugar machinery in the trade between various Continental countries. The United States and Canada also produce beet sugar, and for the industries of both countries the equipment is obtained almost exclusively in the United States. The largest demand for American sugar machinery comes from North American customers, including Cuba, Dominican Republic, Mexico, Canada, and the six Central American republics. South America stands second, almost every country appearing regularly as a purchaser from this source. Insular possessions of the United States—Hawaii, Porto Rico and the Philippines—are important markets for the American sugar industry. Extensions of trade are to be expected in Canada, where land is plentiful and beet culture is spreading, and in Mexico, which is promoting a revival of cane culture in the state of Morelos, formerly the centre of the sugar industry. Central and South America and the West Indies will undoubtedly continue to furnish valuable markets. British countries and possessions provide the chief outlet for exports of sugar machinery from the United Kingdom. The West Indian possessions, British India, Natal, Mauritius and British Guiana, with the other British possessions, purchased 40 per cent. more machinery of this class in the six years from 1920 to 1925 than did all foreign countries during this period. Java, Argentina, Brazil, Peru and Portuguese East Africa are the best non-British markets. Sugar is not produced in large quantities in the French colonial possessions; accordingly the market for French machinery lies in foreign countries, among which Brazil, Peru, and Argentina make the best showing. Germany is making some progress toward recovering its pre-war trade in exports of sugar machinery and apparatus. On the basis of volume the exports of 1925 and 1926 are about one-third of those of 1913. Very little detail is available regarding Dutch exports of machinery for sugar making. The great bulk of exports goes to the Dutch East Indies. There is still a large field for development of mechanical appliances in the sugar industry. Hand labour, which is costly in the western world, is still depended on for digging beets and for much of the work of planting, cultivating and cutting cane. When satisfactory machines are developed for these purposes a large market will be open to them. (*Chamber of Commerce Journal*, Vol. LIII, p. 343.)

The Editor requests that any subscriber who fails to receive *Tropical Agriculture* regularly should communicate with him immediately in order that the matter may be rectified.

JUTE.

(*Corchorus capsularis*) (*Corchorus olitorius*).

BY ROBERT S. FINLOW, B.SC., F.I.C., I.A.S.,
Director of Agriculture, Bengal.

THE jute of commerce is practically a monopoly of North-Eastern India. Some fibre of *Hibiscus cannabinus* is exported from Madras, as Bimlipatam jute, and from Java; also fibre of *Arbutilon sp.* is produced in China; but the proportion of these to the whole is not sufficient to seriously affect the accuracy of the opening statement. North-Eastern India consists of the provinces of Bihar, Bengal and Assam. A recent development of jute cultivation has taken place in the Ganga tract, in the Eastern portion of the United Provinces, as a result of which it is estimated that there may be 10,000 acres of jute. Dr. Leake, late Director of Agriculture in the United Provinces, with Mr. B. C. Burt, now Secretary of the Indian Central Cotton Committee, advised by the writer, the Government Fibre Expert, may be said to be responsible for this latest extension of jute cultivation.

An uncertain amount of jute, roughly estimated at 50,000 bales, sown on, say, 20,000 acres, is produced in the portions of the kingdom of Nepal bordering on the Provinces of Bengal and Bihar.

In 1927, the apportionment of acreages and yields of jute was as follows:—

	Acres.	*Bales.*
Bengal	2,962,100	9,054,700
Bihar and Orissa including Nepal ..	241,000	717,000
Assam	168,000	458,000
United Provinces ..	10,000	25,000
	3,381,100	10,254,700

Thus, as a rough approximation, it may be said that Assam and Bihar with Nepal together produce about 12 per cent. of the jute supply while the remaining 88 per cent. comes from Bengal.

In Bengal jute cultivation and extraction reaches its greatest efficiency; for in Bihar, the climatic conditions are not so suitable, and, in Assam, jute cultivators have hitherto been less careful in preparing the fibre. Probably also lack of experience may be a factor. Otherwise there is no reason why the rich soil and suitable climate of Assam should not produce many times its present quantity of fine jute. This appears to be in process of achievement because of the large emigration into Assam of Mahommedan cultivators from Mymensingh, the tract in Bengal where the finest jute in the market is produced.

There are two kinds of cultivated jute, viz.:—

(*a*) *Corchorus capsularis*, or round fruited jute;

(*b*) *Corchorus olitorius* or long-fruited jute;

The two are different species and so far all attempts to cross them have failed. Emasculated flowers of one species, fertilised with pollen of the other, have set and ripened seed; but the latter has never germinated.

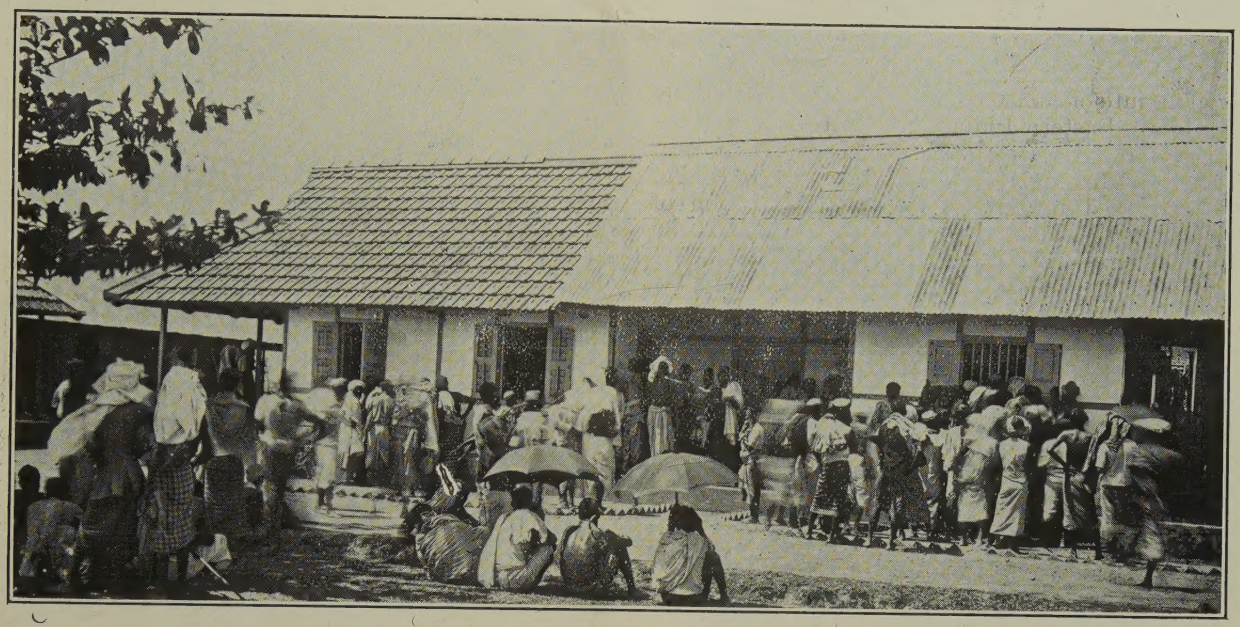
The respective fruits are characteristic; also the seeds are small and greenish-black in *C. olitorius* and rather larger and reddish-brown in *C. capsularis*, but it is somewhat difficult at first for a layman to distinguish between growing plants of the two species. On investigation, however, it is quite easy to point either out at a distance. *C. olitorius* tends to grow straighter, on the whole, than *C. capsularis* and it has rather larger leaves. Among more detailed differences, the under surface of the leaf of *C. olitorius* has more prominent ribs which, after a time, are sufficient to enable one to distinguish one species from the other with closed eyes. Finally, *C. capsularis* contains a bitter glucoside in both plant and seeds, while *C. olitorius* does not. The former is known in the vernacular as *Tita pat* (bitter jute), and the latter as *Mitha pat* (sweet jute).

Culturally *C. capsularis* differs from *C. olitorius* in that, for fibre, as distinguished from a seed crop, the earlier in the season it is sown the better. On very low land liable to deep immersion, *C. capsularis* is commonly sown in the middle of February. The same is the case in Bihar, where there are comparatively few pre-monsoon showers and where surface soil moisture does not usually last much beyond the end of January. On the other hand, if *C. olitorius* be sown before the middle of April it does not develop one straight stem, but reverts to the wild state and becomes a bush branching and flowering prematurely. On this account it must be grown on high lands because a late sown crop on low land would usually be water-logged by early rains. On high lands *C. olitorius* can also be sown to a later date than would offer any prospect, of a good crop of fibre with *C. capsularis*. For production of seed, both *C. capsularis* and *C. olitorius* should be sown late on high land. Neither will mature seed satisfactorily on low land, where water lies late, and, on high land, early sown jute is liable to fungus diseases such as *Rhizoctonia sp.*, *Diplodia corchori*, &c.

These cultural characteristics reflect the climatic features of the respective tracts where *C. capsularis* and *C. olitorius* are grown. For instance, Assam and Eastern and Northern Bengal get early showers, which enable the bulk of *C. capsularis* jute to be sown before the middle of April. On the other hand, the Presidency and Burdwan Divisions, where *C. olitorius* is grown, do not generally get any rain of importance before the beginning of May after which sowing of *C. olitorius* goes on until the 1st week of June, nearly two months after the completion of sowings of *C. capsularis*.

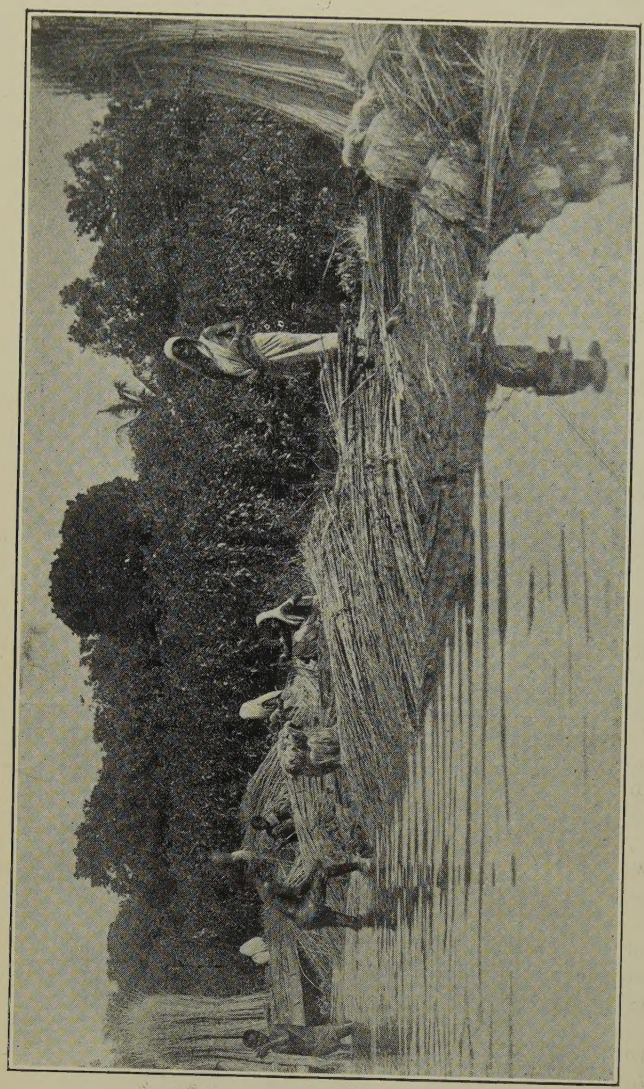
On the whole it may be said that *C. olitorius* is a highland jute, *i.e.*: that while it is not killed by standing in water for a time, when more or less mature, it is grown on land which is not normally inundated, beyond such water as remains on it as the result of heavy rains. By contrast, *C. capsularis* is cultivated on land which often becomes immersed to 6 feet or more before the crop is cut.

JUTE.

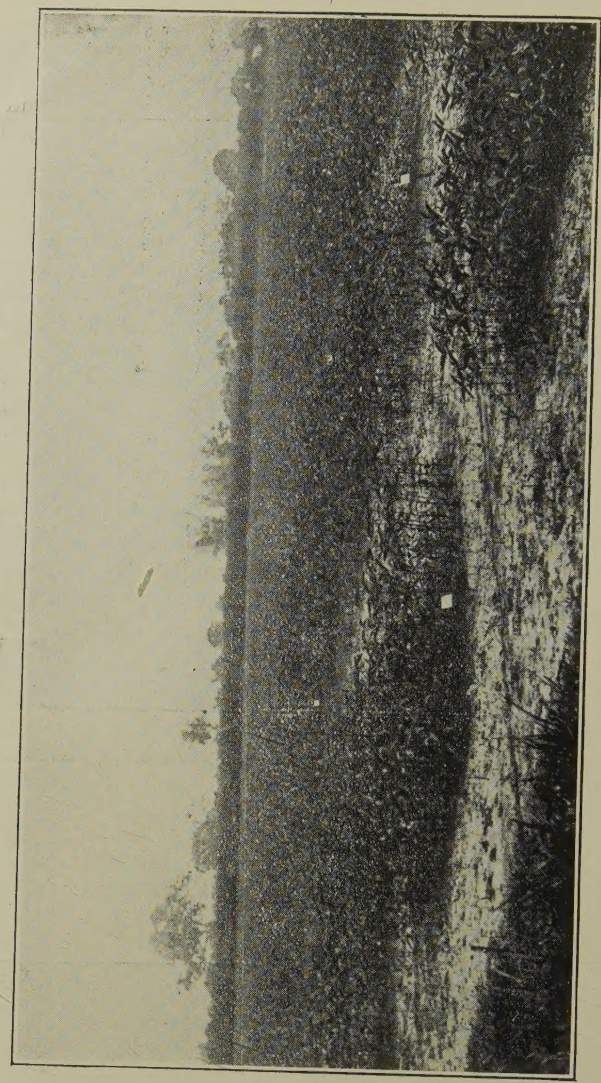


Cultivators purchasing Government Jute Seed at the Dacca Farm.

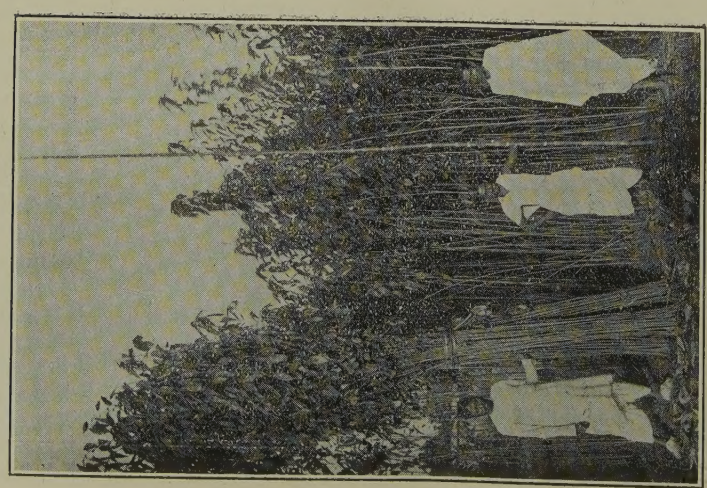
A crop of D154 Jute—("Corchorus capsularis.")



Retting and Stripping Jute.



Jute Pure Line Selection Area at Dacca.



A Crop of Chinsura Green Jute.
("Corchorus olitorius.")

It is not however to be concluded from this that either species of jute is a swamp plant. Few crops are more sensitive to excessive moisture in the soil than jute in its early stages, and a young jute crop, once water-logged will never fully recover, even if the land is drained, or dries, afterwards. It is probably here that more mistakes in experiments with jute have been made than at any other stage. It may be taken for granted that ideal conditions of warmth and moisture such as would suit a typical highland tropical plant (Sugar-cane for instance), are exactly those which jute requires in its earlier stages.

Jute can be cultivated on most kinds of soil which have depth; but the plant is a rapid grower, producing from ten to twenty tons of green matter in from 100 to 120 days. Therefore the land must obviously be in good condition, with plenty of available plant food. Acid soils do not suit jute, without liming, and, like other fibre plants jute is a potash lover.

The seed of jute is small and a fine seed bed is therefore essential. It may be drilled or sown broadcast. Drills should be about 6 inches apart. If the seed is drilled about 4 lb. of seed per acre is sufficient. If broadcast, about 9 lb. is necessary. It is assumed that the seed has good germination capacity. After sowing the seed is lightly harrowed, and the surface is then slightly compacted by drawing a chain harrow or a light log of wood (*Henga*), or a bamboo ladder (*Mooi*), over it. Germination takes place in about 48 hours. Rain followed by hot sun tending to form a crust (*papri*) on the surface should be broken by a light harrow before it hardens. This harrow, known as an *achra*, is drawn by a pair of bullocks and is merely a log of wood (6 inches section and about 4 feet long), through which passes a single line of iron teeth. The teeth are about ½ inch cross section at the base and taper towards the point. A handle attached to the beam enables the pressure on the teeth to be adjusted. Weeding and thinning take place when the crop is 2-3 inches high, and plants should be thinned from 4 inches to 5 inches apart. A drilled crop is cheaper to weed and thin than one which is broadcasted; but in either case the regular use of the *achra*, before the crop reaches the weeding stage, saves hand labour in the latter process.

After thinning, in normal weather of alternate sunshine and rain, jute grows rapidly, and a crop sown in the middle of April may be from 7 to 10 or more feet high by the middle of July, when cutting of *C. capsularis* usually begins. *C. olitorius* matures later than *C. capsularis* and is only ripe, *i.e.*: at the flowering stage, about the end of August.

Cutting can be done with a reaping machine in fields which are big enough, but this is usually impossible in Bengal, where the average plot is only about ⅓ acre, and where the sickle is always used. About 30 men are required to cut and steep an average crop of jute in a day, assuming that water for steeping is near by.

For steeping, the cut jute is tied into bundles about one foot in sectional diameter. Sometimes the bundles are not steeped immediately, but left for two or three days in rows of bundles, so arranged that only the leafy portions of the bundles are exposed. In this way the leaves wither and, during the process, the stems begin to sweat, thus softening the bark and shortening the steeping period. If extra fine fibre is the object, the bundles, after shedding of the leaves, are placed upright for 3 or 4 days in water about 2½ feet deep. This enables retting to commence first in the tougher lower portion of the stems, and tends to ensure more even retting when, subsequently the whole bundle is immersed.

Retting is a bacterial fermentation, which is not the work of one, but of two, or possibly more groups of organisms. The speed of retting depends chiefly on the temperature of the water, the optimum appearing to be about 95°F (say 35°C). At this temperature the retting of an ordinary crop would be complete in from 8-10 days. At about 80°F (say 27°C) about 14 days would be required and, for lower temperatures, the time increases rapidly.

In Eastern Bengal, the retted fibre is usually stripped from each stem singly, beginning at the base of the stem. The stripped fibre is thoroughly washed in water, dried, and rolled into bundles, or baled, for the market.

The stripping process is a tedious one, particularly with unskilled labour. A very good man, doing piece work, may strip 80-100 lb. of dry fibre a day; but labour unused to the work might produce only about 7-10 lb. of dry fibre. In the latter case, of course, the expense of production is largely increased.

In the past, the cultivator's jute used to come into the world market through a series of at least 3 middlemen, but with an improvement in his financial state, the cultivator is tending more and more to deal direct with the local representatives of big firms. Co-operative jute sale societies are also being organised, but these are still more or less in the experimental stage. In any case the fibre ultimately comes to large centres like Narayanganj, Cjandpur of Sirajganj, where it is sorted into "marks" and baled either in 3-maund (1-maund=80 lb. approximately) bales for the Calcutta mills, or in 5-maund bales for export by sea.

The cost of production of jute is a matter of considerable interest. The only means of conveying information to those unfamiliar with Indian conditions is to enumerate the various processes and state the number of men or bullocks usually required. The cost in any tract can then be ascertained by multiplying the amount of labour employed by its local cost.

For Bengal the following may be taken as more or less typical:—

	Per acre *Rs.*
Cost of seed	4/-
5 ploughings and 5 *mocis* (harrow) 5 pairs of bullocks and 5 men ..	22/8/-

	Per acre
Brought forward ..	Rs. 26/8/-
Sowing broadcast (2 men)	1/-
Manure (4 tons F.Y.M. per acre) and cost of spreading; 2 carts with 2 men and 2 pairs of bullocks ..	12/-
Achra or harrow (say one pair of bullocks and 1 man)—twice ..	3/-
Weeding and thinning (once)—30 men per acre at—/8/- as. per day ..	15/-
Cutting and steeping—30 men and 1 pair of bullocks	16/-
Stripping and washing (average of 40 lb. per day per man), and assuming 16 maunds (say 1,300 lb) per acre—32 men ..	16/-
Drying and bundling—(4 men) ..	2/-
Cartage to market (1 cart and 1 man with 1 pair of bullocks) ..	2/-
Rent of land	6/-
	Rs. 99/8/-

This estimate provides for 107 men-days and 10 pair-of-bullock-days, and the cost of a man and a pair of bullocks has been taken to be about Rs. 1/8/- per day, while the daily wage of a man may be annas 8 (eight) only.

An average yield of fibre is about 16 maunds (1 maund is equal to 80 lb. approximately) per acre, so that the average cost of production would be from Rs. 6/- to Rs. 6/8/- per maund, assuming that hired labour is employed. In actual practice the cultivator and his family often do nearly all the work on the jute he cultivates, excepting the weeding, and, in a favourable season, he may avoid hiring labour even for this. Thus the actual cash disbursement is often small and the bulk of the sale proceeds of the fibre come into the cultivator's pocket. Assuming an average price of about Rs. 9/- per maund of fibre, and an average yield of, say, 16 maunds per acre, the gross value of a jute crop is about Rs. 145/- per acre, in addition to the value of the stick or "shive," from which the fibrous bark is stripped, and which is used for fuel and for light fencing.

Excepting on very low lands, jute is usually followed either by transplanted paddy, or by a *rabi* (cold weather) crop like mustard, pulse (lentils or gram), grain (wheat or barley). On other land which is not growing jute, an autumn broadcast rice crop is usual, and is followed by the transplanted paddy or a cold weather crop.

Speaking broadly, it may be said that, on an average the cultivator grows enough rice or grain to feed himself and his family, and to export about 10 per cent. of the produce. Most of the sale proceeds of the jute crop also come in as cash and this is used for the purchase of clothing, corrugated iron for house building, salt and luxuries, such as umbrellas, cigarettes, &c. The average price of jute has about doubled in the last 25 years; also the price of rice has largely increased. The Bengal cultivator therefore receives more cash now than he used to, and this is reflected in the largely increased use in recent years of umbrellas, boots, cigarettes and other luxuries.

It should be added that, as a result of the work of the Bengal Department of Agriculture, improved races of jute yielding, on an average, about 25 per cent. more than local types, now occupy a considerable and rapidly increasing proportion (at present estimated at 20 per cent.) of the total area of jute. Thus the jute cultivator has the alternatives of either increasing his production of jute by 25 per cent., or of producing the same amount of fibre on 25 per cent. less land. In the latter case of course he is able to cultivate a correspondingly greater area of food crops.

N.B. Rs. 1/=16 annas=1*s.* 6*d.*

CEYLON TEA IN 1927.

THE year 1927 has, like its predecessor, been an excellent one from the producer's point of view, and official figures to hand make very satisfactory reading for shareholders in rupee concerns.

The total offerings at public auction on the Colombo market during 1927 were 1,303,315 packages (113,315,549 lb.) an average price of 94½ cents being realised. This compares with 1,234,963 packages (105,446,576 lb.) at an average obtained of 98½ cents for 1926. Though the average fetched was 4 cents (¾*d.*) lower than the year before, an increase in teas catalogued of 8,000,000 lb. was shown being easily a record total for this market.

Comparative offerings and averages for the last seven years are interesting showing the prosperous course of the industry since the slump period of 1920:—

		Packages.	*Lb.*	*Cents average.*
1920	..	1,071,334	88,411,749	42.78
1921	..	873,069	74,188,794	71.18
1922	..	883,804	74,996,916	86.47
1923	..	968,260	83,072,806	Rs. 1.02¾
1924	..	1,133,685	95,912,281	Rs. 1.04¾
1925	..	1,181,975	101,010,049	96¼
1926	..	1,234,963	105,446,567	98½
1927	..	1,303,315	113,315,549	94½

Quality on the whole has been good, and it is satisfactory to record that careful manufacture is taking pride of place and receiving due reward in the steadier prices and keener competition ruling for Ceylon teas on all markets of the world.—(*The Commercial*, Vol. XVI, No. 401.)

We have to acknowledge, with thanks, the gift of the Annual Reports of the Department of Agriculture of Trinidad and Tobago, 1910-1924, which have been presented by the Director of Agriculture.

WEST INDIES ROOT DISEASE.

Root disease in the British West Indies and a note on Diaporthe perniciosa Marchal or a closely related species.

BY H. R. BRITON-JONES.

(*Concluded.*)

Macrophomina Phaseoli in Lime.

SYMPTOMS or rhizomorphs of *S. repens* were found on all the root systems examined both in the field and the laboratory with the single exception already mentioned. A deliberate search was made for this plant because it was highly desirable to obtain a specimen which showed the primary stages of disease. The symptoms as shown by the defoliation and death of one branch of the tree were similar to those which have previously been considered to be due to red-root (*S. repens*). For a distance of about a foot above ground level, however, there was a copious exudation of gum from the trunk. The plant was uprooted carefully and taken to the laboratory for further examination. Only one main root was diseased, and that only on its upper half and on the portion near the crown. This is another point of similarity between this and so-called red-root. The diseased plant was sawn off just above the fork where the main trunk gave rise to three branches. This was about ten inches above the ground. The wood on one almost complete half of the branch corresponding to the diseased area on the root was grey in colour. The other half was normal. The cut end of the branch was pared with a knife, swabbed over with alcohol and flamed. Small portions of the innermost diseased region of the wood were then transferred to culture medium. Of the three cultures made two became hopelessly contaminated with common air-borne species of fungi such as *Aspergillus flavus* and with bacteria. The third was also somewhat contaminated, but not to anything like the same extent. The main growth developed was *Macrophomina Phaseoli*. It has already been stated that the root was only diseased near the crown, the remainder of the whole root system including the finer roots being normal in appearance and with no trace of any fungus infection.

This in the main agrees with Small ([12-14]) who states that *M. Phaseoli* is the forerunner of all the fungi which have previously been found associated with root disease in the East. The young tree alluded to above had been planted on a mound which was above the general level of the ground. The soil below the surface was exceptionally dry and the roots had grown down almost perpendicularly for a distance of two feet or so after planting. (*Vide* also under "Predisposing Factors.")

Fomes Lignosus.

Before discussing the several factors which have contributed to the epidemic in Dominica, it may be noted that on several of the diseased roots examined there was found a mycelium growing on the bark which agree with descriptions of *Fomes Lignosus*. It is not possible, however, to identify this white mycelium from many others. Dead stumps and trunks of lime trees left lying about on the ground after the trees had died were invariably found to develop the fruiting bodies of *Fomes Lignosus*. They have also many times been observed in the dead halves of branches still on the trees. Thus there is here as much evidence for the parasitism of *F. Lignosus* as is given by Petch ([8]). This fungus has also been recorded as a parasite of Cacao. It is extremely common on felled castilloa rubber trees in cacao plantations in Trinidad, and although close watch has been kept on it for a year or more in certain sections, no sign of the spread to cacao has been observed. At present it is not eliminated entirely as a possible factor, but these observations strongly support those of Small ([12-14]). It is not a primary parasite and if it contributes at all towards the killing of the plant, it is in the capacity of a very weak parasite. It is of no consequence whatsoever from the practical standpoint.

Predisposing factors to Root Disease in Dominica.

None of the aforementioned fungi with the exception of *Pythiacystis citropthora* and *Phytopthora parasitica* can be considered primary parasites. Whether or not one or both of the above were present in Dominica has not been determined. In the one case of gummosis examined in the primary stages the fungus isolated was *Macrophomina Phaseoli*, but how widely spread this fungus is was not determined either.

The disease or group of diseases was found in the valleys and on the hillsides; on well drained land and on badly drained land. It should be pointed out, however, that lime trees growing on a slope are not necessarily in well drained soil.

Floods.

Nowell ([7]) has stated that "the incidence of the disease (Red-Root) suggests its origin from the forest, and in new clearings that infection has been directly transferred from logs or on the roots of stumps; in other cultivations from infested material brought down by floods." Cases have been recently observed, however, where the disease was spreading up very steep slopes. In some localities in the valleys, however, floods are important because they bring down soil and other vegetable debris which settles in the plantations and covers that portion of the bases of the trees which was previously uncovered. This, in itself, weakens the tree very considerably. Even in the absence of parasitic or semi-parasitic fungi it is likely that rotting of the bark would take place. The presence of various weakly parasitic fungi like *Macrophomina Phaseoli*, and *S. repens*, however, would add to the damage. The last flood was in October, 1924, but it must be remembered that the result of the silting up of the crowns is acumulative in its action. In the dry season it will be checked, and will again progress during the next rainy season.

Hurricanes.

In July, 1926, Dominica experienced a somewhat severe hurricane which blew down many lime trees and wrenched a good many others. This would give a full grown tree a very serious check. The epidemic started in November, 1926. This factor, however, is not of general application.

Wither-Tip disease.

Wither-Tip is so severe in some localities that it causes a great deal of defoliation. It also checks new growth by killing back the young twigs. It is thought by some that Wither-Tip alone in some cases causes the death of lime trees. This view cannot be accepted, but the combined effects of severe attacks of Wither-Tip and the abandoning of a field which follows such attacks possibly kills them or renders them susceptible to the action of weak parasites.

" Die-back " disease.

The dying back of branches is a disease which is often found in places where conditions of soil are not altogether suitable for limes. It can also occur on good soil which is subject to the effect of drought. Furthermore, it follows Wither-Tip and the factors mentioned under that heading. " Die-back " is itself a manifestation of weakness so that more serious trouble following is only what can be expected. There were signs that " Die-back " disease had been of long standing in many localities.

Weeds.

It is no exaggeration to say that a good many of the plantations are weeded only once a year and then only just sufficiently well so that the ripe and fallen limes can be collected. These weeds, apart from any other serious effects on lime trees, retain moisture and cloak in the crowns of the trees so that they are kept wet for long periods at a time.

Pruning.

In the majority of cases the larger limbs which have died back are hacked off and the jagged ends, sometimes a foot or more in length, are left on the tree. The result is that the dying back progresses down to the crown and main roots and serves as seats of infection for fungi. It is doubtful if the removal of these large limbs is necessary, except on rare occasions, if the lime trees are well looked after.

Close Planting.

All the commercial lime fields examined are far too closely planted. The trees in some cases are forty to fifty years old and are planted ten to fifteen feet apart. Indeed fields are now being cultivated which were originally planted as shade for coffee many years ago. Further, the edges of these fields are protected by windbreaks of lime trees grown as hedges and planted three feet apart. Under such conditions cultivation is not possible, and the weeds take charge. Even fields planted during the last few years have been planted at distances varying from twelve to twenty feet apart. This practice is sometimes advocated because it is considered desirable to form a canopy as quickly as possible to keep down weeds, and so that the lime tree can prune itself. It is also said to reduce the cost of maintenance.

The more modern view is that citrus orchards should never be covered in. There are several very sound horticultural and pathological reasons why sun and air should be allowed through a citrus orchard. The shade created by seedling lime trees as grown in the West Indies is never sufficiently dense materially to influence the growth of weeds. Weeds can grow luxuriantly in all, but the difference between open spacing and close planting is that in the former weeds can be kept down by green cover crops which can later be cut and used as a mulch, whereas in the latter it is almost impossible to keep down weeds owing to the low and interlocking branches.

Artificial Fertilisers.

On many of the estates sulphate of ammonia has been used exclusively as manure for lime trees for several years in the past. The disastrous effect of such a practice is well known. Not only does it make the soil acid, but the plant will on a good many soils suffer from potash deficiency. The question of lime requirement of the soils of Dominica is a matter which might quite profitably be investigated. Liming of the land was recommended as a measure against root-rot because it floculates clay, renders the soil less acid, and accelerates the breaking down of humus. By floculating clay it makes drainage and cultivation more effective from a pathological point of view. For the same reason the breaking down of humus and reduction of soil acidity makes the soil a less favourable medium for fungi.

Insect Grubs.

It will be noted that not one of the factors so far dealt with can be applied to all the estates inspected. It is clear, however, that one and sometimes more than one plays its part as a predisposing factor to root disease in the different localities. On the other hand, there was one factor and only one which was present on all the several root-systems examined. This was the damage caused by insect grubs. The grub was not identified and only one specimen was collected. This was about $\frac{3}{4}$ inch in length, almost white in colour, and the dark coloured contents of the alimentary canal were visible through the semi-transparent body. The body was somewhat bent dorsoventrally and swollen at the hinder end. It had three pairs of legs.

The damage caused was considerable in many cases, and in all cases the cortex had been eaten away as far as the wood. The grub eats its way along the root for varying distances up to a foot or more, sometimes more or less in a straight line and at others in a curved and twisted manner from one side of the root to the other. At the edges of the groove callus is formed to close the wound completely in slight cases. In others the callus is confined to the edge of the groove and the wood is exposed. If no further complications set in the wood turns black. Observations showed

that the fungus *S. repens* had gained entrance through a good many of these wounds. Whether *S. repens* was preceded by *M. Phaseoli* could not be determined. These grubs eat the cortical tissues of roots of all ages except the very fine ones and regularly attack just under the crown. The writer considers the damage caused by these grubs of great importance since it was the only constant factor found on all the diseased plants examined in the valleys and on the hillsides. It is interesting to note that the roots of some healthy young trees of seedling limes, as well as those on rough lemon and sour orange stocks, were also attacked. In spite of the fact that sour orange roots are attacked, not a single case of root disease was observed wherever limes or other citrus fruits like grapefruit and Washington Navel oranges had been worked on this stock. This is an entomological problem which calls for thorough investigation in connection with root disease of limes in the West Indies just as there are several mycological points which need further study before the relative importance of the many factors involved are thoroughly understood Three insect larvae have been previously recorded ([17]) attacking the roots of citrus trees in the West Indies, namely, the two weevils *Diaprepes abbreviatus* and *Exophalmus escuriens*, and *Lachosterna* spp. of the family *Scarabeidae*.

Control.

The palliative measures recommended are those usually practised against mal di goma, coupled with an all round higher standard of horticulture. The ultimate aim should be, however, to replant limes worked on sour orange or rough lemon stock at a height of 12–18 inches above ground level.

There are, however, various other very important factors to be taken into consideration which cannot be dealt with in this paper.

Diaporthe perniciosa or a closely related species.

In his latest publication to hand, Small ([14]) states as follows :—" Diplodia die-back of rubber, for example, has been found in all recent cases to be accompanied by Rhizoctonia root disease. In other words, it is conceivable that the Diplodia die-back is nothing more or less than a symptom of the presence of root disease underground, the Diplodia fungus which is only a weak parasite being unable to cause a die-back unless the tree is failing in health from another cause . . . Die-back of the aerial parts of a tree is to be regarded, on the whole, as a symptom of other trouble, most probably of root disease, and I am not prepared to believe in an independent fungus cause of die-back of local woody plants unless I am convinced that root disease is not present, especially *Rhizoctonia bataticola* root disease."

Just as in the case of root disease the writer feels that Small ([14]) is again generalising too much on his findings in connection with " Die-back." Furthermore, it is very possible that in following his predecessors in the question of *Diplodia* " Die-back " of rubber, he has missed in the aerial parts a fungus which, in the writer's view ([3]), corresponds to his *Macrophomina Phaseoli* in the roots.

Microscopical and cultural studies of organisms occurring on branches of Rubber (Hevea), Camphor, Gliricidia and Cacao suffering from " Die-back " disease in the West Indies show that the fungus *Diplodia* is not the first organism to invade the tissues of the branches. The following table is a list of the fungi found in the tissues :—

Host.	*Fungi isolated.*	*Fruit bodies on bark.*
Camphor	*Diplodia* spp. *Cytospora* spp. and *Phomopsis* spp.	*Diplodia* spp. *Cytospora* spp. *Phomopsis* spp. and Valsa spp.
Rubber	*Diplodia* spp. *Cytospora* spp. and *Phomopsis* spp.	*Diplodia* spp. *Cytospora* spp. and *Phomopsis* spp.
Cacao	*Diplodia* spp. and *Phomopsis* spp.	*Diplodia* spp.
Gliricidia	*Diplodia* spp. and *Phomopsis* spp.	*Diplodia* spp. and *Phomopsis* spp.

In all four cases the fungus *Phomopsis* spp. and *Diplodia* spp. have been isolated. On the other hand, when isolations from the very edge of the diseased tissues were made, the fungus which was obtained in culture was in nearly all cases on all four hosts the fungus *Phomopsis* spp. This fact is very significant. The fungus *Phomopsis* spp. is very like the conidial stage of *Diaporthe perniciosa Marchal*, and if not the same, it is a very closely related species or strain. The latter fungus is well known in association with " Die-back " in fruit and other trees in England. Without going into the extensive bibliography on " Die-back " disease in general, it has been accepted in the West Indies ([7]) that the fungus *Diplodia* spp. is secondary in importance and follows a physiological check due to one or more causes. There is, of course, the possibility that in a large number of cases the arrival of *Macrophomina Phaseoli* on the roots is sandwiched in between the physiological check and the dying back of the branches, but this is certainly not *always* the case. Likewise, the fact that the fungus *Phomopsis* spp. has recently been found to be the forerunner of *Diplodia* does not affect the practical issue except that it makes " Die-back " of cacao, rubber, camphor, and gliricidia in the West Indies similar to " Die-back " in England. *Diaporthe perniciosa*, according to the writer's view ([3]), is also secondary, and follows a check due to various causes. It would be interesting therefore, to learn whether the fungus *Diplodia* spp. in " Die-back " of rubber and possibly other plants in Ceylon is preceded by *Phomopsis* spp. Whether the underground cause is always *Macrophomina Phaseoli* in Ceylon, the writer is not in a position to express an opinion, but it is

certainly not in England. "Die-back" in England is primarily caused by various physiological factors, including:—(i) Excessive soil moisture due to lack of drainage; (ii) Potash deficiency in the soil; (iii) Following infection by *Stereum purpureum*; (iv) Following root-rot by *Armillaria mellea*. One or more of these render the plants liable to infection by *Diaporthe perniciosa*. Dozens of root-systems were critically examined and cultures made, but in no case was *Macrophomina Phaseoli* found. Furthermore, "Die-back" of plum trees in England has been reproduced experimentally without fungus inoculation but by scorching the root-system with sulphate of ammonia. After leaching the soil the plants recovered. In the case of "Die-back" in the West Indies no root-systems have been examined. The material of camphor and rubber was collected at Reunion in St. Lucia, which is a district very liable to drought in the dry season and where these plants die-back in most years, but they soon recover when the rainy season sets in. Even if *Macrophomina Phaseoli* was at a later date found on their roots this would supply further evidence to show that this fungus is not a primary parasite.

Acknowledgments.

The author is very grateful to Mr. J. B. Hutchinson for his kindness in allowing him to carry out observations on his experimental plots at the Research Station of the Empire Cotton-Growing Corporation, and to Professor E. E. Cheesman for similar observations on his plots at the Imperial College of Tropical Agriculture. To Mr. S. F. Ashby of the Imperial Bureau of Mycology for sending cultures of *M. Phaseoli* and for keeping him posted with recent developments.

TRINIDAD AGRICULTURAL BANK.

A REPORT for the third financial period ending 31st December, 1927, by the Chairman of the Board of Management of the Agricultural Bank of Trinidad and Tobago, states that 38 out of 85 applications received for loans on mortgage and 37 out of 41 applications for temporary advances had been approved. A profit of £809 10s. 0d. was realised, which reduced the deficit of £1,169 18s. 5d. on 31st December, 1926, to £360 8s. 3d. on 31st December, 1927.

The recommendations made by the Officers of the Department of Agriculture who have continued to inspect the properties mortgaged to the Bank have in the majority of cases been adopted by the owners and resulted in improved cultivation and increased output. Of the 23 properties against which loans have been made, a sum of £82,635 8s. 4d. has been borrowed by 194 properties up to 100 acres in extent and of £60.333 6s. 8d. by 39 properties of between 100-500 acres. A Profit and Loss account and a Balance Sheet are appended to the Report.

AGRICULTURE IN MAURITIUS.

1927 Progress Report.

Weather Conditions.

DURING the period under review, temperature was practically normal. Heavy, and in some localities, torrential rain was in evidence during the first decade of August. In September, rainfall was irregularly distributed but without heavy down-pours; in October, it was, generally somewhat in defect.

Weather conditions have thus been, during the past three months, favourable, upon the whole, to crop operations and milling processes.

Crop Progress.

Milling operations are progressing satisfactorily. Considerable disappointment is experienced in relation to cane yields, the cause for which, however, is not as yet clear. On the other hand, the sucrose content of the cane is, as a rule, satisfactory.

Consequent on the reduced tonnage in the field the crop forecast issued at the end of May is likely to be markedly in excess of the harvested crop and, at the time of writing the probable figure of 225 thousand tons has been arrived at as against a preliminary forecast of 243 thousand tons.

Sugar Market.

The market was generally dull during the period under review. The total disposed of up to date by the Mauritius Sugar Syndicate amounts to 81.4 thousand tons of vesou sugars at Rs. 10.36 net per 50 kilos together with 2.2 thousand tons of extra fine at Rs. 10.10 net per 50 kilos.

Sugar Movements.

Up to the end of October, the total sugar exported since 1st July was 62.6 thousand tons as compared with 29.7 at the same epoch last year.

Tobacco Industry.

Interest in tobacco cultivation continues to be maintained. Large quantities of plants and seed have been sent out from the Department of Agriculture's nursery, and steps have been taken for the establishment of pure line strain of seed by mass selection and progeny row methods. The Tobacco Growers Association has been inaugurated and discussions are in progress with a view to legislation for the control of tobacco diseases and the question of seed supply. Laterly a very marked improvement in the quality of the leaf has been seen and a very fine run of high grade flue cured leaf was exhibited at the Agricultural Show held in Pamplemousse in September. The question of organising an export trade is engaging serious attention. It is believed that no real degree of stability will have been achieved until a regular export trade shall have been established. At present the Department of Agriculture is discussing with the Association the question of forming a voluntary export pool, to which members will contribute an agreed on fraction of their production for export at intervals of every month

or two months. The idea being to create a definite place on the market in England for Mauritius tobacco, so as to facilitate sales when production shall have arrived at a sufficient volume to necessitate export on a large scale. The selection of leaf for export will be performed by the Department of Agriculture which will also take charge of the grading, preparation and export of the leaves.

Mauritius Hemp.

The Central Baling and Grading Factory of the Mauritius Hemp Producers Syndicate was opened by His Honour the Officer Administering the Government in September. The installation which has been made with the aid of a subsidy from Government of Rs. 100,000, comprises a steel building fitted with electric overhead cranes for handling produce and electrically operated hydraulic presses. A rigid system of grading has been established and the scheme has been in full operation since the middle of October. As a result, interest in this product has already increased and for the first time 12 bales of the new Superior Grade instituted as the result of discussion between the Agricultural Department, the Syndicate and the London representative, have gone forward. Up to the 11th of November 487 bales of fibre had been pressed by the Syndicate; the appearance of these bales offers a very striking contrast to the type of bale ordinarily exported.

Fruit Canning and Preserving.

During the last three months, considerable progress has been made with the scheme for establishing a Fruit Canning and Preserving Industry. A Committee under the Chairmanship of the Director of Agriculture has drawn up a scheme for the establishment of a Canning Factory and the plantation of about 200 acres of pineapples by planters under contract with the proposed factory. It is hoped that part of the Capital required will be raised locally by public subscriptions, while the Government are being approached with a view to a grant-in-aid to the undertaking. From the information collected it would appear that a scheme of this description offers very considerable prospects of success.

Tea.

There has been a good deal of discussion with regard to the local tea industry, consequent on the decision of Government to reduce the import duty on foreign teas from 60 cents to 40 cents per kilo. This industry has maintained a more or less precarious existence for 40 years, and it is concluded that for economic reasons the cultivation of this plant offers small prospects of commercial success in the Colony.

Stock Questions.

The campaign for the eradication of Surra has been continued on normal lines. The total number of animals examined for the year to November has been 12,195 while the number of cases of Surra detected has been 58. During the period under review the Government contributed the sum of Rs. 30,000 from the Development Fund as a subsidy in aid of the stock industry of the Island. The fund will be administered by a Committee under the chairmanship of the Director of Agriculture.

Plant Pests and Diseases.

During the period under review the Assistant Director of Agriculture communicated results obtained in an extensive series of experiments with Calcium Cyanide (Cyanogas) for the control of Phytalus. The results indicate that this insecticide may probably find very useful application in the treatment of infected fields of plant canes, but not so much so in ratoons. Experiments with Paradichlor (Paradichloro Benzine) with which good results have been reported in Queensland were found to give negative results on Phytalus in Mauritius.

The most important occurrence is the bringing to light of the extensive occurrence of Gummosis on canes. The Botanical Division of the Department of Agriculture had during the past two years repeatedly called attention to the increasing prevalence of this malady and in consequence a general survey was undertaken during the crop season of the canes going into factories throughout the Island, the Assistant Director of Agriculture being in charge. The result has fully confirmed the fears previously expressed and energetic action on the part of planters is necessary to deal with the situation. It is striking that White Tanna is the most seriously affected.

Agricultural Shows.

A very successful agricultural exhibition was held under the auspices of the Department and Board of Agriculture at Pamplemousse on 24th and 25th September, and was largely attended.

Agricultural Education.

The Laureateship of the College of Agriculture was awarded to Mr. Raymond Olivier. The final draft rules for the projected Farm School were submitted to Government during the period under review, and it is hoped that the scheme will be got into working order by January next. The scheme provides for the recruitment of 8 boys from the Elementary Schools each year, who will undergo a course of training of 2 years' duration. From the best of these there will be annually selected pupils to fill Cadetships in the Agricultural and Forestry Departments, from which eventually appointments will be made of Forest Rangers and Junior Grade Agricultural Officers. A scheme for the regrading of appointments in the Agricultural Department is now under consideration by the Secretary of State and if approved the Farm School and the adjoined Cadetship will provide for the establishment and recruitment of lower grade appointments in the Agricultural service, recruitments for which have in the past given difficulties from time to time.

H. T.

SIERRA LEONE FRUIT.

Possibility of Establishing an Export Trade.

A COPY of a "Report on the Question of establishing Fruit Growing for Export in Sierra Leone" by Mr. M. T. Dawe, O.B.E., Commissioner of Lands and Forests, has recently been received. The report includes an account of Mr. Dawe's impressions of the citrus industries of California and Florida. Although his figures are not as comprehensive as one would wish they may prove to be of interest. Citrus products of Florida during 1925-26 were valued at over $50 million. The cost of planting and upkeep of a citrus grove until it reaches bearing age, ranges from $250 to $500 an acre, exclusive of the cost of land but including interest at 8 per cent. on the money invested and all labour charges. Good citrus land ranges in value from $50 to $150, or even more, per acre, according to quality, distance to city shipping, port, &c. The annual cost of maintaining a grove after it reaches bearing age averages $75 to $150 per acre. Mr. Dawe does not indicate precisely what operations are covered by the term "maintaining." Profits are said to vary more than costs, high profits being obtained on the best groves, while losses are incurred on some poorly cared groves.

Well cared orange and grape fruit trees in good soils reach bearing age at the fourth or fifth year yielding from a fourth to a half box of fruit per tree. The crop increases annually at the rate of about a quarter box for oranges and a half box for grape fruit until full production is reached about the tenth year. Exceptional groves yield 500 boxes per acre, or even more, of grape fruit or oranges in a single season, but only the very best groves average more than 200 boxes annually. The average yield for Florida is about 150 boxes to the acre or somewhat less than 2 boxes to the tree. There are commercial groves in Florida producing profitable crops at an age of thirty or forty years.

In California the Navel orange season commences in December and lasts till June, and the Valencia season from May till December, so that production is practically continuous. The operating costs of a well cared grove vary from $200 to $300 per acre annually, and returns should be from 350 to 500 boxes of saleable fruit per acre.

Dealing with the prospects in Sierra Leone, Mr. Dawe estimates that the Colony, has an area of at least 50,000 to 60,000 acres available for fruit growing. The average annual rainfall in California is 22 inches, in Florida 57 inches, and in Sierra Leone it varies from 150 inches on the coast, to 90 inches in the interior. Irrigation is necessary in California, but not in Florida where there are frequent rains from April to November. The rainy season of Sierra Leone coincides more or less with that of Florida, but is more than twice as heavy. The months from November to March are very dry, especially when the harmattan winds are blowing, and during this period irrigation would probably be essential. The Sierra Leone soils are principally laterite on which citrus trees appear to thrive providing it is not too gravelly. Comparison of soils with California and Florida is not possible. It is proposed to establish two Experimental Fruit Farms, a terraced one on a hillside at Masampa near Benquema, and a lowland one near Newton, the two stations being at a distance of 7 miles connected by a road which could be made motorable at reasonable cost. Both are to be located in the Eastern section owing to the larger area of available citrus land (about 40,000 acres) and to the fact that the soil differs from that of the western section.

Mr. Dawe urges that co-operative marketing which has done so much for California and Florida is even more necessary in Sierra Leone and considers it essential that organisations which can take care of harvesting, packing, grading and shipping should be established from the commencement. He hopes that if a few Europeans can be induced to take up fruit growing, as in French Guinea, their example will soon be followed by Africans.

Grape fruit from Florida takes 14 to 18 days to reach the United Kingdom market via New York, whereas grape fruit from Sierra Leone could reach the United Kingdom market in 11 to 12 days.

The report is profusely illustrated.

C. Y. S.

FRENCH GUINEA FRUIT.

A REPORT on the Fruit Industry in French Guinea by Mr. D. G. Thomas, B.SC., Assistant Conservator of Forests, Sierra Leone, forms Appendix II of Mr. Dawe's Report.

Mr. Thomas states that the cultivation of fruit for export is mainly in the hands of European (French) planters, and the principal fruits grown are bananas and pineapples. In 1924, 399 hectares [1] (European 180, Native 219) were under bananas, and 52 hectares under pineapples. The principal markets are Dakkar, Senegal (12 days), France (9-12 days) and Morocco. During the last four years the exports being as follows:

Year.	*Bananas. Tonnes.* [2]	*Pine-apples.*
1923	904	—
1924	982	42
1925	1,534	63
1926	2,320	40

The plantations are strung out along the railway from Conakry to Mamou, and the soils are light loams of good depth. For planting, sheltered hollows are chosen away from the north-east wind, natural shelter being preferable to the planting of shelter belts of trees. There are about 500-800 plants per acre and the yield

1.—Hectare =2·47 acres.
2.—Tonne =2,295 lb.

is about 20-25 tons[3] of fruit per acre. On pages 59-60 of the Report detailed figures are given on cost of production and this works out at 2.48*d.* per lb. In the opinion of the investigator, the flavour and texture of the fruit is superior to that of the Canary Islands. It also has the quality of travelling well.

Labourers are difficult to obtain in the plantation regions. They are poor in quality and are paid from 3*d.*-5*d.* per day with rations and lodging. The Government regulates the conditions of indentured labour and assists the employer by seeing that the labourer keeps his contract. In the review of the general situation it is stated that transport is one of the chief difficulties. At present fruit is evacuated by ordinary rail wagons, the steamers do not run to schedule and it is often found that there is insufficient deck space to take all the fruit that is offered.

Sierra Leone has very similar land and labour conditions and is in a very favourable position with respect to ocean transport. Mr. Thomas suggests that the Government puts down 620 acres of *Musa Sinensis* in the vicinity of Hastings and 10 acres elsewhere, an area which should yield 2-300 tons of bananas for export in 1928. At the same time he thinks that European planters should be attracted to establish a fruit industry and that they should be given every encouragement and be protected against loss from causes beyond their control.

G. W.

3.—English ton = 2,240 lb.

FRUIT PACKING.

APPENDIX III of Mr. Dawe's Report is an account by Mr. D. W. Scotland, F.S.I., Director of Agriculture, Sierra Leone, of the packing of fruit for the British Market. Mr. Scotland who paid visits to fruit brokers in London, Hull and Liverpool discusses in detail the packing of oranges, grape fruit, lemons, limes, pineapples, bananas, avocado pears and tomatoes, mentioning in each case the packing materials that should be used and the grades of fruit required together with other useful information collected for the producer's benefit. Other sections of the Report deal with the sources of supply and costs of packing materials, shipping facilities and the results of experimental shipments of fruit from Sierra Leone. With regard to the latter, it was found that the bananas had been wrongly packed and had been frosted. Oranges were packed incorrectly in peat and ungraded. Both the limes and grape fruit arrived in good condition, but showed too much green. The author is of the opinion that there should not be any great difficulty of shipping sound citrus fruit from Sierra Leone. Bananas, however, should be carried in ship's fruit chambers entirely given up to their transport and kept at the required temperature.

Mr. Scotland in his concluding remarks suggests the introduction of an orange in Sierra Leone that would colour well on ripening, as the present orange grown is greenish or greenish-yellow in colour which is against its popularity in the British Isles. He also urges the introduction of improved methods of packing this fruit. He advises that all shipments of grape fruit should in future be carefully selected and that the fruit sent should be thin skinned and as free as possible from pips. The popularity of this fruit is increasing in the British market, but 72 per cent. of the home trade was in the hands of the United States of America in 1924.

Mr. Scotland stresses the following five points at the end of his Report, which are quoted from the Report on Fruit by the Imperial Economic Committee:

(i) The domination of the United Kingdom market by a United States surplus production.

(ii) The importance of organisation for the purpose of joint marketing.

(iii) The necessity of high quality of the fruit coupled with the highest standards of grading and packing.

(iv) The importance of ensuring that the fruit shall be identified in the retailer's shop by the consumer.

(v) The desirability of correlating advertisement with quality and identification.

The Report contains a mass of information which should be of much value to growers of fruit in the Tropics.

G. G.

BOTANICAL CONGRESS.

WE have received a preliminary notice to the effect that the fifth International Botanical Congress will be held at Cambridge from 16th to 23rd August, 1930, with excursions during the following week.

The members of the Executive Committee are, Dr. F. F. Blackman, Professor V. H. Blackman, Dr. E. J. Butler, Professor Sir John Farmer, Professor F. E. Fritsch, Professor Dame Helen Gwynne-Vaughan, Dr. A. W. Hill, Professor Neilson Jones, Sir David Prain, Dr. A. B. Rendle (*Treasurer*), Professor A. C. Seward (*Chairman*), Professor W. Stiles, Professor A. G. Tansley, together with Mr. F. T. Brooks, and Dr. T. F. Chipp (*Secretaries*).

The subscription for membership of the Congress will be £1 (one pound sterling) and should be paid to the Treasurer, Dr. A. B. Rendle, British Museum (Natural History) London, S.W.7, before 1st January 1930, if possible, or, at the latest, by 1st April, 1930. Correspondence of a general nature about the Congress should be addressed to F. T. Brooks, 31, Tenison Avenue, Cambridge, England, or to T. F. Chipp, Royal Botanic Gardens, Kew, England.

TROPICAL WORLD NOTES.

Nigeria.

It is announced in *West Africa* that Colonel C. N. French of the Empire Cotton-Growing Corporation and Mr. F. L. Engledow, M.A., a member of the Staff of the Plant Breeding Institute of the Cambridge School of Agriculture, reached Nigeria early in March. The main object of their visit has been to study cotton problems in West Africa.

* * *

West Indies.

According to a review of business conditions in the British West Indies published by the Royal Bank of Canada, Montreal, the general trade situation throughout the islands is improving, and a much better tone prevails, collections generally being well met. The Government of Dominica is experimenting with the diversification of the island's products by fostering the growth of coconuts, cocoa, coffee, grape-fruit, oranges, ginger, vanilla and tobacco.

As a result of the seasonable weather in the sugar-producing islands, the 1928 crops are in a very healthy condition. The Trinidad crop of cocoa is earlier than usual, but it is estimated that the new crop will not exceed those of the two previous years, and lower prices as compared with 1927 are anticipated in 1928. In the eight months period, January-August, 1927, shipments of cocoa from Trinidad totalled 41,575,318 lb. (44,939,614 lb. in 1926), from Jamaica 4,782,600 lb. (4,809,800 lb.) and from Grenada 9,463,552 lb.

For some years the shipments of coconuts from the West Indies have been declining steadily, and those of copra rising. Statistics for the first eight months of 1927 show a reversal of this trend, coconut shipments increasing and copra decreasing. Jamaica was the largest exporter of coconuts, shipping 19,974,622 nuts in the period as against 13,729,033 nuts in 1926. Exports of copra from Trinidad declined from 10,097,618 lb. in 1926 to 7,535,508 lb. in 1927, while those from Jamaica fell from 7,575,062 lb. to 6,393,899 lb. Coconuts were exported from British Honduras to the number of 2,627,680 and copra to the amount of 1,247,063 lb.

In view of the falling off in the consumption of Sea Island Cotton, growers are considering planting a smaller acreage next season. It is reported that the inland plantations of limes in Dominica have been entirely ruined by the withertip disease, and only the coastal properties are productive.

The export of grape-fruit is a comparatively new venture, and has grown rapidly during the past few years, exports from Jamaica during 1926 totalling 7,517,000 fruit. Tobacco growing is being instituted and fostered by the governments in Jamaica and Dominica, as both colonies are capable of growing a good grade product. English interests are actively planning the establishment of a banana service between Jamaica and England and a corresponding marketing organization.—(*The Chamber of Commerce Journal*, Vol. LV, No. 726.)

Jamaica.

The year 1927 created a new record for the exportation of bananas from Jamaica. The total cargoes sent away amounted to 21,074,612 stems of fruit, against 18,029,275 in the previous year. Appreciable increases are noted in the general trade of the island. Larger quantities of banana figs, grape fruits, coconuts, honey, pimento, orange oil, coffee, and rum are included in an unofficial statement just issued.

Corn growing is to be undertaken on a larger scale to meet local requirements.—(*Times Trade and Engineering Supplement*, Vol. XXI, No. 501.)

* * *

Sierra Leone.

The total value of imports into Sierra Leone during 1926 was £1,844,122, compared with £2,178,461 in 1925, and comprised, according to a Colonial Report (No. 1359, price 1s. net) published recently by H. M. Stationery Office, Kingsway, London, W.C.2., food, drink and tobacco to the value of £435,761 (£427,460 in 1925), raw materials and articles mainly unmanufactured, £118,789 (£178,138); articles mainly manufactured £1,069,114 (£1,329,461); specie, £218,119 (£237,147). A considerable decrease took place in receipts of cotton piece-goods from £430,987 to £247,604.

Exports from the colony attained a total value in 1926 of £1,871,446, a slight advance compared with the 1925 figure of £1,820,635. The principal items of export last year were benniseed, raw cocoa, ginger, hides, kola nuts, palm kernels, palm oil, pepper, piassava and rice. Shipments of palm kernels were the largest on record, and amounted to 65,000 tons (1,769 tons more than 1925), valued at £1,116,780, the United Kingdom taking 56 per cent., as against 87 per cent. in 1925. Kola nuts shipments amounted to 3,015 tons valued at £246,725, as against 2,442 tons, worth £215,721 in the previous year. Exports of palm oil last year totalled 2,865 tons, valued at £89,032 which is a rather small quantity from a colony whose main wealth is the oil palm.

Of the total import trade, £1,122,617, or 61 per cent. came from the United Kingdom (66 per cent. in 1925); £203,200 or 11 per cent., from the United States; and £168,236, or 9 per cent. from foreign West African possessions. With regard to exports, the United Kingdom took £773,299, or 41 per cent.; Germany £508,119 or 27 per cent.; British West African Possessions, £297,671 or 16 per cent.; and the United States, £46,885 or nearly 3 per cent.—(*The Chamber of Commerce Journal*, Vol. LIV, No. 724.)

* * *

Tanganyika.

Imports into Tanga during the month of December totalled £48,454 while the exports aggregated £86,653. The main item of export was sisal, valued at £63,756, the total shipments amounting to no less than 2,099 tons, of which rather more than half went to Belgium.—(*The East Africa Information Bureau.*)

Uruguay.

Statistics published in *The Chamber of Commerce Journal* and furnished in a recent report of the Department of Overseas Trade by the Honourable E. S. Scott, C.M.G., M.V.O., H. M. Consul-General at Montevideo, show that official figures for the first six months in 1927, indicate that during this period imports were valued at 40,447,895 pesos, and exports at 54,081,065 pesos. The leading exports were wool (19,210,719 pesos) meat and meat extracts (15,478,085 pesos), hides (6,218,267 pesos), living animals, agricultural produce, fats and mineral products.

The livestock industry is by far the most important in Uruguay, and about 95 per cent. of the wealth of the country is derived from animal products, the principal of which, of course, is wool. Wool exports for the 1926-27 season were estimated at 125,000 bales, as compared with 110,000 for 1925-26. The season was regarded as a satisfactory one, and the coming clip is expected to be heavy.

One peso=4*s.* 3*d.*

* * *

Kenya.

Of the new Kenya loan of £8½ million which is being floated in the London Market, it is stated that £667,000 will be devoted to educational and medical buildings, the cost of maize drying and cold storage plant and water schemes, the whole of the balance going to port and railway works. The loan covers works already approved by the legislature and entails no new expenditure. It is intended to repay the Colony's commitments to the British Treasury, which are a first charge on the revenue, and the advances made by the Crown Agents pending flotation.—(*Empire Mail*, Vol. XVI, No. 12.)

* * *

East Africa.

With reference to the native coffee industry it is stated in a report by the Secretary and Executive Officer of the Uganda Local Advisory Committee, that very few Robusta coffee seedlings have been distributed to natives this autumn, partly owing to the lack of rains, but chiefly owing to the decision to hold over the seedlings until they reach a more advanced stage. The nurseries, however, are well stocked for distribution in the spring rains.

"The present native coffee crop is reported to be coming in, in fair quantities and to be realising good prices—40 to 44 cents per lb. for Robusta and 52 to 56 cents for Arabica in Kampala and the surrounding districts.

"The cultivation of Arabica coffee by natives is to be encouraged in the Kigezi district of the Western Province, which has proved suitable for this type of coffee and, with this end in view, nurseries will shortly be established. The altitude of this district is considered too high for Robusta coffee."—(*The Produce Markets Review*, Vol. XCIV, No. 3167.)

Sudan.

The Sudan has made great strides in cotton growing. The report of the High Commissioner for the year 1926 shows that it was the first year in which large-scale cultivation of cotton was attempted in that country and that excellent results were obtained. The extent of the expansion of cotton growing may perhaps best be illustrated by the fact that in 1926 exports of cotton were 22,159 tons, or rather more than the amount exported in the preceding three years together. The Gezira was the chief contributor to this increase, and it may be noted that the revenue from the Gezira project was considerably in excess of the expenditure entailed. As to the future, the report suggests that the expansion should continue, and that there is not likely to be much difficulty in securing an adequate supply of labour to pick the crop. The rain-grown American varieties in the south are likely to be affected by the conditions of demand and supply for the American crop, but the outlook for Sudan Sakellaridis is quite good, and Lancashire will doubtless remain a good customer.—(*The Commercial*, Vol. XV, No. 393.)

* * *

St. Lucia.

The 1926 Colonial Report on St. Lucia (No. 1364, H.M. Stationery Office, Kingsway, London, W.C.2, price 6*d.* net) the publication of which seems to have been somewhat delayed, states that the total quantity of sugar produced during the year was 6,021 tons, as compared with 5,564 tons in 1925, but there was a further decrease in the output of rum which totalled 34,161 proof gallons, as against 45,762 proof gallons in 1925. There has been no extension in the area under cane, which remains at about 4,750 acres. Exports of cocoa during the year declined slightly at 10,036 cwt., but improved in value from £22,339 to £22,454. Increased attention has been given to lime cultivation in St. Lucia, and the industry is now the second most productive in the colony. The crop of limes in 1926 amounted to 59,415 barrels, and the value of lime products exported was £28,245, as compared with £27,835 in 1925. The production of coconuts has increased with a number of young trees coming into bearing, and much of the crop is dealt with at local mills in the manufacture of oil and soap. Exports of coconut oil in 1926 amounted to £3,846, and of copra to £1,808.

Banana production has increased considerably during the last two years, and the present annual yield of all Gros Michel cultivations in the colony is estimated at 70,000 bunches. Owing to a weak American market, the bay oil factories of St. Lucia dealt with a smaller crop than in 1925. An increased crop of Sea Island cotton was raised and realized a good price, and by further attention to apiculture a good honey crop was made and in 1926 exports totalled 129,152 lb., valued at £737, the quantity being nearly treble that shipped in the previous year.—(*The Chamber of Commerce Journal*, Vol. LV, No. 729.)

COTTON NOTES.

Gossypium.

SIR GEORGE WATT, *Bull. Misc. Inform. Roy. Bot. Gard.* Kew No. 5, 1926 and No. 8, 1927.

Sir George Watt is well known as a botanist who has devoted much time to the taxonomy of cotton, and is the author of that well-known work of reference, *The Wild and Cultivated Cotton Plants of the World*, a work which, by reason of the vast amount of detail which it contains, finds a place in the library of every student of cotton. This book was first published in 1907, and twenty years later, Sir George Watt now endeavours "to amend and amplify, and in some instances correct, the particulars given in *The Wild and Cultivated Cotton Plants of the World.*" In 1907 there were very few workers on Cotton. Balls in Egypt and Leake in India were conducting valuable genetic experiments, but nothing was known of the cytology of cotton, and experimental data on the relationships of the various types of cotton did not exist. A book such as the *Wild and Cultivated Cotton Plants of the World*, the work of a pure systematist, could therefore be welcomed in 1907 as a valuable addition to the literature, for it collected together accurate descriptions and illustrations of species, and proposed a scheme of classification for cottons which at the time seemed a fairly consistent one.

Since 1907, however, much water has flowed under the bridges. The literature on cotton, both on the technological and on the pure botanical sides has swelled to gigantic proportions, and at the present time, we probably know more about cotton than about any other economic plant. The cytological and genetical studies of the past twenty years have shewn that Sir George Watt's classification is artificial, and based on inconstant and superficial characters. It is not accepted by any cotton worker of repute, and is now merely of historical interest. Sir George Watt has emerged after twenty years silence and inflicted two papers on us. They are written in the same style and with the same outlook as his book, and we must express our frank surprise that an institution so renowned for sound taxonomic studies as the Royal Botanic Gardens of Kew should lend itself to the publication of such a type of taxonomic treatment as sets the geneticist aghast.

It may be helpful if we indicate our position as geneticists to the taxonomist. We believe that with the help of the geneticist, cytologist, ecologist and physiologist, a sane system of classification could be made out, which would indicate lines of descent and phyllogenetic relationships in the genus *Gossypium* and which would be helpful to the working botanist. But we have no use whatever for the labours of the old-fashioned herbarium taxonomist. Nay more, we consider his efforts mischievous and misleading, when they are not actually useless. We could, if we were malicious, take a half grown plant of the well known Okra cotton, cut it in half, send it to the taxonomist and get the top half described as *G. Schottii* and the bottom as *G. hirsutum*. We tremble to think of what would happen if we sent him the F_2 of a cross between a Bourbon (*G. purpurascens*, Poir) and a Peruvian type cotton such as Kidney cotton (*G. brasiliense*, Macf.). A dozen or more species would see the light of day, since to the taxonomist the number of new species he is going to describe is highly and positively correlated with the number of herbarium sheets available, especially when his "sole criterion of a species is the difference which he thinks he sees between one herbarium specimen and another." (Clement.)

Without the wider vision imparted by genetics and cytology, the outlook of the herbarium taxonomist is quite hopeless, but as long as he confines himself to describing sheets of "bush" from the wilds of Central Africa he will not be interfered with; let him, however, when dealing with a well known economic plant such as cotton, refrain from cutting across established facts in genetics and cytology, and let him not make new species without full and deep consideration of cytological and genetic data, for in both cases he will be heavily smitten. Let him withdraw from circulation all base taxonomic coinage, *i.e.*: any species which proves to be merely a simple Mendelian variation of another species (*e.g.*: *G. Schottii*, which differs from *G. hirsutum* merely in having recessive laciniated leaves). It has been stated above that the classification of the genus *Gossypium* proposed by Watt is of doubtful value, and before passing on to a criticism of the two papers cited at the head of this article it is necessary to give reasons for this opinion. Discussing which characters of the genus *Gossypium* are of taxonomic value he states as follows:—"The most instructive characteristics are derived from the position and condition of the bracteoles; the presence or absence of nectar yielding glands; and the nature of the floss and fuzz that surround the seed." Of these he ultimately attaches most importance to the seed covering, assigning second place to the adnation of the bracts.

It is now certain that the joining of the bracts is too inconstant and superficial to be of much use as a taxonomic character. All the Asiatic cultivated cottons have joined bracts, but in New World cottons it is possible to find both joined or free bracted forms as varieties of the same species. Thus there are Sea Islands, Uplands, and Egyptians with both free and joined bracts.

The nature of the floss and fuzz which surround the seed affords no better guide to the taxonomist. Most cultivated cottons have sub-varieties with seeds (*a*) entirely lacking in fuzz (*b*) completely fuzzy (*c*) many intermediate grades. In both Upland and Sea Island cottons, types have been seen not only without fuzz but also without lint. It is possible to take any New World cotton and give it any combination of the taxonomic characters considered by Watt to be

important, without altering its essential features. Upland would still be Upland and Sea Island would still be Sea Island.

Recent cytological work by Denham in England and Nikolajeva in Russia has shewn that the cultivated cottons fall into two great groups, the Asiatics with 13 pairs, and the New World cottons with 26 pairs of chromosomes respectively. Of the so-called wild cottons, *G. Stocksii* and *G. Davidsonii* have 13 pairs while *G. tomentosum* has probably 26 pairs. The chromosome number of *G. Sturtii* is not known. These facts were not known to Watt in 1907 but the main grouping into 13 chromosome Asiatic and 26 Chromosome New World has been known to and appreciated by most cotton workers since Denham's paper was published in 1923. In his book Watt continually assumes that Asiatic and American cottons readily intercross and that certain of the Indian cottons have been produced as a result of such crosses. On page 152 (*Wild and Cultivated Cotton Plants of the World*), he states as follows :—

> "Tellapatti This is the black seeded cotton of South India . . . There would seem little doubt that this is a naturally produced hybrid between the Uppam and Bourbon cottons . . . A clear study seemed to justify the transference of Tellapatti cottons to the position of undoubted hybrid states between the so-called Asiatic and American stocks."

In point of fact, as Zaitzev has recently shewn, hybrids between New World and Old World cottons are capable of being made, though with extreme difficulty. Such hybrids are completely sterile and have never been observed to set seed, either with their own pollen (which is mostly shrivelled and bad) or that of the parents. It is therefore not possible for American cottons to have played any part in the formation of any modern cultivated Indian stock. Watt, however, in 1927 is apparently unaware that cytology has anything to do with taxonomy and describes a Chinese cotton (evidently an ordinary *G. arboreum*) as a new species, calling it *G. anomalum* and suggesting, that it is a cross between a *G. arboreum* (13 chromosomes) and *G. purpurascens* (26 chromosomes).

In the first of the papers cited Watt describes the following new species from Africa and India.

G. Simpsonii.	*G. Transvaalense.*
G. Soudanense.	*G. Abyssinicum.*
G. Africanum.	*G. Bakeri.*

They are all Asiatic cottons and apparently only varieties of the four great stocks of cultivated Asiatic cottons, *arboreum, Nanking, herbaceum,* and *obtusifolium.* There does not seem to be the slightest reason for making them into new species, particularly as genetic studies more and more confirm the idea that there is only one species of cultivated Asiatic cotton, under which can be placed as agricultural varieties the four above ecologically differentiated races.

In the second of the two papers, more new species are described :—

G. nervosum.	*G. Marie-Galante.*
G. Birkinshawii	*G. pedatum.*
G. Harrisii.	

The writer is acquainted with three of the above "species." *G. Birkenshawii* is simply one of the innumerable types of Bourbon cottons—all varieties of *G. purpurascens Poir.* *G. Marie-Galante* is described from a single plant growing among the welter of Bourbon-Peruvian which constitute the ordinary *Marie-Galante* commercial stock of the Grenadines. If either of these constitute new species then we can produce about two or three hundred more, until we get to the *reductio ad absurdum* of describing every different Mendelian combination as a new species. In regard to *G. pedatum,* the Cauto cotton, which was described by Mr. T. Sprague as *G. brasiliense var. apospermum* Sprague, the situation is similar. Sprague was wrong in describing it as "*apospermum*" for the seeds are very often fused in pairs and the type is thus partly Kidney. Cauto is a pure line of the usual Peruvian-Brasiliense series, and Sprague is correct in describing it as virtually a free-seeded form of *G. brasiliense.* The boll is not quite so long or pointed and there are a certain number of small differences which decidedly do not entitle it to specific rank. Here it may be remarked that "Kidney" seed is a rather minor Mendelian character—probably a triple recessive, and one could undertake to produce all the well known varieties with Kidney seeds, at least those with naked or tufted seeds.

The above review confines itself to a criticism of Watt's two papers on the taxonomy of *Gossypium,* but the same general objection may be taken to a recent paper by O. F. Cook, and J. W. Hubbard* which describes some unnecessary new species from Central America, all evidently types of the Upland group.

S. C. H.

* New Species of Cotton Plants from Sonora and Sinola, Mexico—*Jour. Wash. Acad. Sci.* 16 : 333, 1926.

PALM OIL IN WEST AFRICA.

A FOUR months' visit to British West Africa by Mr. F. M. Dyke, technical officer of the Niger Company, Limited, and associated companies, for the purpose of investigating the palm-oil industry, is the subject of an interesting report just issued. Mr. Dyke finds that the more accessible palm areas are being thoroughly cropped, and that there is little scope for expansion on present lines except by opening up areas which are at present inaccessible owing to lack of suitable transport. But native methods of making oil are extravagantly wasteful of both produce and labour, besides producing an oil of very variable quality. It is this phase of the work, therefore, which most requires attention.—(*The Times Trade and Engineering Supplement,* Vol. XXI, No. 502.)

CORRESPONDENCE.

PLANT BREEDING.

[*We publish herewith a criticism made by Mr. Charlton of an article on "Plant Breeding," which was published in the 1927 November issue of "Tropical Agriculture," with comments by the author and Professor E. E. Cheesman*—ED.]

To the Editor of "Tropical Agriculture."

Sir,

My attention has been drawn to an article in *Tropical Agriculture*, November, 1927, Vol. IV, No. 11, page 207, viz.: "Plant Breeding" by J. B. Hutchinson, B.A., in which data from my paper a Selection of Burma Beans for low HCN content (*Memoir of the Department of Agriculture in India*, Chemical Series, Vol. IX, No. 1, 1926) is criticised from the botanical point of view.

It was known from the start, *i.e.*: about 1916 that Selection of Burma Beans would most probably result in no improvement as regards HCN content. Orders were to the effect that this should be actually demonstrated by practical experiment failing other satisfactory proof. I took over the work in February, 1921 and merely carried out selection work from best individual plants to show that *Phaseolus Lunatus* did not respond to selection for low HCN content. This is not clearly stated in my *Memoir of the Department of Agriculture in India*, Vol. IX, No. 1, but it was never thought possible that the context of the memoir in question would have given rise to the idea that I believed that a HCN-free variety would be obtained by selection (other than a mutant). I may therefore quote the following to clear up the position:

(1) *Annual report of the Agricultural Chemist, Burma, for the year ending 30th June*, 1923.

Page 4. "Although much work on the occurrence of cyanogenetic glucosides in *Phaseolus Lunatus*, &c., has been done an extensive search has failed to show a published account of the results of the selection on HCN content. At the present time it cannot be stated that Burma Beans respond to selection for low HCN content. No sustained attempt seems to have been made and since the question seemed to be an open one, the author commenced this work as early as possible, viz.: in 1921-27."

Had such a published account been available and this is of course, expecting the impossible, it would have been possible to have avoided carrying out a work which was regarded as hopeless from the start.

(2) *Annual report of the Agricultural Chemist, Burma, for the year ending 30th June*, 1924.

Page 5. "Prussic acid is a normal character in *Phaseolus Lunatus* and even if a mutant were found containing no HCN, this mutant would be a bean of a quite new type and would not be a *Phaseolus Lunatus*. Not the least hope now exists that such a mutant will be found. Already considerably more than 3,000 individual plants have been examined and in every case HCN was found."

Unfortunately the annual reports do not seem to have the same circulation as *Memoir of the Department of Agriculture in India* and whereas all workers in India were probably quite well aware of the real object of the work, unfortunately this does not appear to be the case elsewhere.

In brief then, whereas it was from the start considered that HCN could not be eliminated from Burma Beans by selection, the work had to be carried out to convince people without knowledge of plant breeding that selection within a pure line was futile. There was, of course, the chance of discovering a mutant. Had the advice of competent agriculturists available been accepted, the work would not have been undertaken. Hence, to undertake such a work at all, it was necessary to assume that the impossible was possible in order to give the work the fairest possible trial in practice.

(*Sgd.*) J. CHARLTON,
Agricultural Chemist,
Mandalay.

Comments.

There are two comments which may be made on Mr. Charlton's letter:—

1. That an experiment which was undertaken against the "advice of competent agriculturalists" and has yielded entirely negative results, is not of sufficient importance to be published as a *Memoir of the Department of Agriculture* in India.

2. That the criticism still holds, that by calculation of parent-offspring correlations for HCN content, it would have been demonstrated in 3 years—instead of 7—that selection was a waste of time.

J. B. H.

Having also criticised Mr. Charlton's paper in a later issue of *Tropical Agriculture* (though my note was actually written before Mr. Hutchinson's appeared in print, and was quite independent) I should like to add a third comment, viz.: that had parent-offspring correlations been calculated the demonstration of the purity of the lines concerned would have been final, whereas on the data given, although the existence of pure lines is a reasonable certainty to the geneticist, there is, as I pointed out, no strict proof of it, owing to the same fault which Mr. Hutchinson emphasizes—absence of families propagated from any individuals but those selected for low HCN content.

E. E. C.

TRINIDAD MOTHS.

A CATALOGUE of the Trinidad moths forms No. 3 of the Memoirs of the Department of Agriculture of Trinidad and Tobago (1927). The authors, Mr. J. W. Kaye and Sir Norman Lamont, Bart., mention that they have found 1,016 species but it can be safely assumed that half of the smaller species are not yet known. From an economic point of view the number of injurious species is not large. Only 28 species of moths have been found which can be considered as habitual or occasional pests to agriculture and horticulture.—(*Nature.*)

COFFEE IN KENYA.

Report of the Proceedings of the Kenya Coffee Conference.

THE first conference was convened by the Department of Agriculture of the Colony and Protectorate of Kenya in accordance with a request of the Coffee Planters' Union, and took place at Nairobi in June, 1927. In his opening speech, His Excellency the Acting Governor, Sir E. B. Denham, K.B.E., C.M.G., pointed out that Kenya is the most important East African producer of coffee, and that East Africa is the second largest supplier of coffee to British markets, Costa Rica coming first. Over 700 estates in Kenya produce coffee, more than 1,000 European males are directly dependent on it, and it gives direct employment to at least 35,000 natives throughout the year. The acreage at present is about 70,000, the tonnage annually increasing—at present 8,000 tons—and the area is gradually extending so that to-day over 30 per cent. of the Colony's exports are scheduled under coffee valued roughly at one million pounds.

At the conference resolutions were presented on subjects such as soil fertility, pests and diseases, &c., by the District Associations. These were discussed and finally recast or amended in accordance with the suggestions of other associations, so that in the end general opinion was reflected.

The final resolution on Cultural and Experimental Work read as follows :—

" That this Conference advocates the establishment by Government of experimental coffee plots in the various areas in the Colony under the control wherever possible of resident scientific officers, or technical officers, of the Department of Agriculture, with the object of determining, *inter alia*

(*a*) the effect of the various types of fertilisers.
(*b*) the best method and most effective rotation of application.
(*c*) the incidence and control of pests and diseases.
(*d*) the marking of mother trees for seed selection.

The discussion was mainly concerned with detail; should the land be leased or rented? What size should the plots be? &c. It was pointed out that with the various conditions in the country, entomology, mycology and manurial experiments could not be dealt with by one man. The Chairman, the Acting Director of Agriculture, said that four farms would be required to meet the needs of the Colony, but the Government could not afford to pay for four officers and four stations. He informed the Conference that the Department hoped to have three Travelling Laboratories in order that officers would be able to work in different districts.

A good deal of attention was devoted to the regularity and frequency of plantation inspection. If advice is to be given to planters and the inspectors are to ensure that the diseases of plants regulations are applied, a relatively large staff is necessary. It was suggested that provision should be made in the next year's estimate for the appointment of District unofficial plantation inspectors but this was referred back to the District Associations in the amendment.—" That this Conference refer to District Associations the question as to whether in addition to inspection by Government Officials it is desirable to appoint District unofficial plantation inspectors, either paid or honorary, such inspectors to have the full powers of official plantation inspectors with the proviso that it shall not be competent for them to order destruction of coffee trees or other plants without the written consent of a competent coffee officer."

The resolution on soil fertility concerned reduction in railway rates on cattle and sheep manures and it was suggested that " even if such manures were carried at a loss to the railway the Government would be more than compensated by the increased yields and subsequent prosperity."

The type of compensation the Government would get seems vague, but one would think the planters would not be unwilling to pay an economic rate if the benefits to be derived from manure are so apparent. From an administrative point of view, railway rates should be arranged to cover expenses when there is a normal utilisation of the line. Policy usually dictates that low rates be charged for freight such as manure, and the Railway Department gave assurance that reduction would be sympathetically considered if more traffic would result.

One section raised the question of the difficulty of having soil analyses carried out. It was stated that in the working out of a manurial programme soil analysis was of very little value and that the Department would arrange for the publication of an article dealing with the points of analyses useful to coffee planters.

Legislation on praedial larceny is necessary throughout the tropics. The Kenya planters in their discussion of coffee sales and thefts expressed obvious dissatisfaction with their existing ordinance and it was decided to appoint a Committee to go into the question with the Attorney-General. A resolution that " the onus of proof of legitimate possession of coffee should lie with the person found in possession " was passed unanimously.

The discussion on estate management centered round the experiments with Liberica and Robusta Coffees and the possibility of their cultivation by natives in reserves. It was pointed out that the Department desired if possible to establish the productive value of other and unexplored coffee areas. In response to a request for the Government's attitude to native coffee growing it was stated that there was no likelihood of natives being permitted to grow coffee in the highlands and on the question of natives in other areas growing coffee other than Arabica no decision had been promulgated as the question had not been raised.

In dealing with financial provisions there was an obvious desire for increased official help. The attitude of the Government was declared by Sir E. B. Denham in his opening speech. After pointing out that the overhead charges on special staff for coffee work amount to about £3,500 and that the Government had recently approved an expenditure of some £2,400 on two additional entomologists, he stated "I hope that you will realise that at any rate the Government is sympathetic and is trying to forward the interests of the coffee industry. But in view of all the interests in the country, there must be a limit to expenditure in a particular industry however important that may be. There should be some measure of self help, and I believe that the coffee industry to-day is in a position to give such assistance." One speaker mentioned that the Coffee Planters' Union for a long time had been discussing the question of a cess on a £1 for £1 basis, to provide for scientific services for the industry. They had come to the conclusion generally that the industry was not yet sufficiently established to enable them to make that provision which the Government was anxious to see. The resolution under discussion was "That in view of the great importance of the Coffee Industry to the whole community Government should provide sufficient and essential services for the protection of the industry, out of general revenue" and it was carried by 18 votes to 2. The question as to how far a country can go in providing scientific agricultural service for a particular industry depends a good deal on the financial state of the country and the economic importance of the industry. Large agricultural enterprises in the tropics often employ their own scientific staff and there seems no reason why the coffee planters of Kenya could not maintain co-operatively the particular additional agricultural scientists they require.

G. W.

CEYLON LABOUR.

WE learn from the *Ceylon Observer* that according to Official Statistics the number of Indian estate labourers and their dependants who emigrated from South India to Ceylon in 1927 reached the record total of 159,398. This increased immigration has been partly due to the determined efforts made by the estates in 1927 to recruit labour direct from India instead of resorting to the plan of securing labour from other estates. Since labour control came into force in 1924 Ceylon has for the first time an adequate labour supply. It is estimated that there are now over 700,000 Indian estate labourers in the Island.

The subscription to *Tropical Agriculture* is six shillings per annum, post free, Trinidad currency, to all countries within the British Empire or seven shillings, post free, Trinidad currency, to all other countries. Subscriptions can commence at any time during the year.

AGRICULTURE IN SOUTH AFRICA.

[REVIEW of the progress of Agricultural Industry from the *Official Year Book* of the Union of South Africa, No. 8, 1910-1915, The Government Printing and Stationery Office, Pretoria, Price 5s. pp. xxx+1130.]

Fifteen years is a long time in the history of a young country like South Africa, and the progress that has been made in the period covered by this publication is sufficient justification, if such were needed, for this volume of over 1,100 pages, containing not only very full statistics showing the development of the country's resources, but a number of most interesting special articles dealing with aspects of South Africa's progress as a nation. Special attention is called in the Preface, to the fact that this is the first Year Book to be translated into Afrikaanse (it was apparently compiled in English) which since 1925 has been recognised as one of the official languages of the Union, instead of into Nederlands, as heretofore.

Of the twenty-eight chapters which cover all the activities of the administration and give a very full account of the present state of the country, one of the most important, and to readers of *Tropical Agriculture*, probably the most interesting, is Chapter XIII, which deals with Agricultural and Pastoral Production.

From the tables of production which cover the period, and in many cases go back some years earlier, non-native farming is seen to have made steady if somewhat slow progress. Maize is pre-eminently the crop of the country and has shown the greatest increase: in 1904, to go back to the period shortly after the Boer war, the total production was 361,000 tons; in 1925, it was 2,429,558 tons and was worth over £12,000,000 or about one-ninth of the total agricultural production of the Union. It may indeed be argued that such a great dependence on a single crop is an unhealthy state of things, but there is no doubt that the "mielie" has brought great prosperity to many parts of South Africa. The Government has been ready to see the value of the crop and by its system of State elevators has done much to assist the industry. It is an impressive sight, when travelling through the flat and rather dreary maize-producing areas of Eastern Transvaal, to come to an insignificant dorp, commanded, as by a mediaeval fortress, by one of these immense structures, capable of dealing with 3,000 or 4,000 tons of maize, while the elevators at Cape Town and Durban will be remembered by any traveller who enters or leaves South Africa by either of these ports. The Native production of maize forms no inconsiderable item of this crop; in 1924, the latest year for which figures are available, it was rather more than a quarter of the total production.

Expansion in other crops has not been so rapid. Cotton has suffered from being over-boomed, and from the very rapid fluctuations in price which it has experienced in the last decade: 1923-24 the last year for which figures are given,

marked the highest point of production yet attained. Tobacco has decreased and is less now than what it was in 1911, in spite of the efforts of a number of Co-operative Societies, which, whatever one may think of their interpretation of the word Co-operation, have undoubtedly been of great help in improving the sale price of tobacco. The great increase in the production and export of fruit is more encouraging and the figures are rather wonderful. From 1910 the value of fresh fruit exported has jumped from £46,600 to £464,000: dried fruits from (1915-16) £8,200 to £882,000.

The livestock industry, in a similar way, is steadily developing, each year showing a regular increase in the number of cattle in the country. In 1924, non-natives owned over 6½ million cattle, natives nearly 3 million, a total of 9·9 million, which has reached this figure from a total of 5·8 million in 1911. The export of beef has, however, dwindled to something very much below the war period figures, though the latest returns show a rise in quantity accompanied by a decrease in price. The manufacture and export of butter and cheese both show improvement, the latter markedly so.

The cause of the somewhat disappointing figures noted above, which are a measure of the development of the farming industry, is due, no doubt, to the rather chancy nature of farming in many parts of South Africa, with its uncertain rainfall and abundant insect pests. There is no doubt that in favourable seasons, very good profits can be made, but it requires considerable self restraint on the part of the farmer, to put by enough to tide over the bad seasons which his optimism suggests to him may not come after all, and self-restraint is not engendered by the get-rich-quick-and-get-out atmosphere which the amazing mineral wealth of the country tends to foster. The land in short, needs more good farmers, and it is satisfactory to note that this is recognised by the South African Government, who, under their Land Settlement Act (Chapter XI), are offering farms to applicants on extremely generous terms.

Realizing further that the lack of water, even for domestic purposes or for watering stock, is in many cases the main obstacle to settlement, they maintain an Irrigation Department (Chapter XII), which is busily engaged on various schemes, while the Boring Department, which cost in 1925 nearly £77,000, with the 49 drills they have in commission, completed 553 boreholes with a total of 90,000 feet actually drilled.

The Agricultural Department which is responsible for guiding and controlling this important industry, costs £900,000 a year, but it may be doubted whether the country gets good value for its money. In the first place, the Service is handicapped by its organisation into eight Divisions which work too independently, under a non-technical Administrative Secretary, though recent changes which have reduced the number of Divisions, have probably improved matters in this respect. Further, the officers of the Technical Divisions do not keep in close touch with conditions or people in the districts: there is a Division of Extension which is supposed to do that, but which is mainly composed of young fellows who have only recently left College. They are not likely in such conditions to carry much conviction to practical farmers, and though they may display a great deal of paper activity "assisting agricultural organisation," it must be largely eye-wash and has little real effect. By contrast, the Veterinary section, until recently under the able guidance of Sir Arnold Theiler is probably one of the most efficient Veterinary departments in the world.

The reviewer cannot refrain from alluding to the very remarkable statements which are made about the American Aloe and the Prickly Pear, and their value as fodder in periods of drought. This is grossly exaggerated, but the statement (p. 433) that these plants are very "palatable" is untrue. The Division of Chemistry (p. 389) are more honest in their statement that "American Aloe fed alone to cows in milk—appears to lead to their early death." The truth is that if these plants provided a large quantity of nutritious and succulent fodder (which they do not), and were grown to any large extent, they would simply increase the carrying capacity of the land, and consequently the number of stock carried, with the result that the effects of a drought would probably be more serious than ever.

R. C. W.

NATIVE WORK.

SOME very useful information has been published in a report for 1926 by the Native Affairs Department of Kenya Colony on the amount of work which a native labourer ought to be expected to do on European plantations in East Africa.

The following are the customary standards of work:

	Amount per diem.
Coffee picking, light crop	6 gallons.
Coffee picking, heavy crop	16 gallons.
Coffee pruning, normal crop	500 to 1,000 sq. yds.
Excavating—(These figures allow a lead of 100 feet, and should be decreased by 15 per cent. per 100 feet, if the distance is greater):—	
Excavating soil; soft	3 to 4 cub. yds.
Excavating medium (black cotton, &c.)	2 to 3 cub. yds.
Excavating hard (murrams, &c.)	1½ to 2 cub. yds.
Excavating rock, soft	1½ to 2 cub. yds.
Excavating rock, hard	1 to 1½ cub. yds.

ENTOMOLOGICAL NOTES.

Compiled by the Department of Entomology.

The Gum Tree Weevil and its Parasites.

The Gum tree weevil according to Mr. David Miller (*Goniopterus scutellatus*) has attracted a considerable amount of attention by its ravages on the foliage of Eucalyptus trees in South Africa and New Zealand. The insect had been introduced to these localities from Australia, where it was known to occur without being a pest of first importance. It seemed to be obvious that this was another instance of the introduction into a new locality of an insect, which away from its natural enemies, was capable of becoming a serious pest.

The study of the parasites of this weevil and the attempts to introduce them into a new locality were taken up by the Entomological Sections of the Departments of Agriculture in South Africa and Australia. Hymenopterous parasites which attack the egg masses of the weevil have been successfully introduced into South Africa, and from there to New Zealand, and there appears to be a strong probability that these will have a very beneficial influence in the control of the pest. (*New Zealand Journal of Agriculture.*)

* * *

The Cane Leaf Hopper.

The sugar-cane leaf hopper of the Philippines (*Perkinsiella vastatrix*) according to a paper by Mr. Cornelio M. Urbino is a pest of sugar cane which appears to be capable of developing to first importance, but it is at present held in check satisfactorily by its many natural enemies. Sugar-cane appears to be the only known food plant of this insect in the Philippines. The injury to the cane results from the lesions in the leaf and leaf sheaths made by the feeding and ovipositing of the insects. Its natural enemies are egg parasites and egg predators, an entomophagus fungus, which attacks nymphs and adults, and predaceous insects feeding on nymphs and adults. The most effective of these is a Myrmarid, which, on the average, parasitizes about 52 per cent. of the eggs and on occasions the rate of parasitism observed has been as high as 98 per cent. It was found that different varieties of sugar-cane exhibited varying degrees of susceptibility to attack by the leaf hopper, and the suggested means of control included the planting of the less susceptible varieties of cane and the encouragement of natural enemies.

The paper to which the above notes refer does not mention the leaf hopper of the sugar-cane which, when introduced in the Hawaiian Islands, very nearly ruined the sugar-cane industry in those islands, and was completely subjugated by the successful introduction of its natural enemies from Australia, which was the native home of the Hawaiian sugar-cane leaf hopper (*Perkinsiella sacharicida*).—(*The Philippine Agriculturalist.*)

REVIEWS.

MARKS OF ORIGIN. League of Nations, Economical and Financial Section. International Conference, Geneva, May, 1927. Price 2*s*. pp. 59.

In the competition for markets of recent years, unfair devices were often used to sell other goods under the marks of those which had found good markets. Governments took steps in the interests of consumers and producers to prevent this. Legislation regarding marks of origin was passed and at a later date became an instrument for the protection of national markets. Regulations differed widely from one country to another making the position of the exporter difficult. Efforts have been made for the adoption of national regulations, and this led to the Paris Convention in 1883 and to the Madrid Agreement in 1891. These agreements, however, regulated the legal position to a limited extent only, and further attempts are now being made to standardise the laws. This publication of the Economic and Financial Section of the League of Nations reviews the present position, and gives a summary of the regulations concerning the marks of origin in the various countries.

G. W.

* * *

THE USEFUL AND ORNAMENTAL PLANTS OF TRINIDAD AND TOBAGO. By W. G. Freeman, B.SC., A.R.C.S. and R. O. Williams. Government Printing Office, Port-of-Spain, 1927, pp. 198. Price 2*s*. 6*d*.

This book is issued as *Memoir* No. 4 of the Department of Agriculture, Trinidad and Tobago, and as stated in the preface is an attempt to bring together in a concise form popular information regarding the useful and ornamental plants, both indigenous and introduced, in the Colony.

It is arranged alphabetically, with most of the species described under their botanical names, and the popular names cross-referenced. The obvious defects of this system are overcome by including all the information about certain plant-groups (such as Ferns and Orchids) under one heading, to which reference is made against the specific name in its proper place, and by the provision of subject and botanical keys, from which one can seen at a glance, for example, what plants suitable for hedges are listed and described, or which genera of Solanaceae are dealt with in the body of the work.

The amateur gardeners of the Colony, and all other residents interested in plants, are very fortunate in having this handy little work of reference compiled for them, and since tropical gardens have elements of similarity all round the world, and many of the species listed are widespread, it is to be expected that it will find in less favoured colonies a much wider sphere of usefulness than its title would indicate.

E. E. C.

CO-OPERATION FOR FARMERS, L. Smith-Gordon, M.A., Williams and Norgate, London, Price 6s. pp. xiv+247.

This book was published in 1918. The history of the co-operative movement since that date clearly indicates that many who have been responsible for the guidance of co-operative societies have failed to read this book. A few quotations from the introduction will serve to indicate the manner in which Mr. Smith-Gordon approaches the subject, "an abstract, if earnest desire to found a co-operative society for the sake of being a co-operator is of little value--- The existence of such a need should (*first*) be established. The type of society will naturally be settled in the first place by the prevalent methods of farming and in the second by the existing facilities and the comparative efficiency and honesty with which they are administered. The promoters should satisfy themselves that a sufficient number of farmers would benefit from the operating of the society and ensure a reasonable chance of success. Before attempting to persuade neighbours to join they must be clear in their minds both as to the economic advantages which they expect to gain and as to the legal and structural form of a co-operative society." These quotations assure one that the author approaches the subject in the correct spirit; his experience guarantees that his advice is practical. The author appears somewhat biased by the historical development of co-operation and his association with the Irish movement, and regards a co-operative commonwealth and the overturn of the capitalistic control of industry, as the ultimate goal. The reviewer finds it impossible to accompany the author thus far, but has found his arguments interesting and stimulating without being conclusive. All co-operators should read this book.

C. Y. S.

* * *

MANUAL OF TREE DISEASES by W. H. Rankin, Macmillan & Co., New York, 1923.

This book is disappointing in that there is little information in it to one trained in plant pathology beyond the list of Latin names given to various diseases. To the practical man it is of little use and often might lead him to much useless expenditure of time and money. For example, in connection with the control of various leaf spots caused by different fungi on different host plants, it is stated that in the forest no direct methods of control are practicable. With shade and ornamental trees it is recommended to rake together and burn all fallen leaves in the autumn. In the case of fungi affecting twigs also the pruning off of all cankered and dead twigs is advocated. Both these are obviously not practicable. In regard to the eradication of lichens on trees it is stated that this is easily accomplished by spraying with Bordeaux Mixture. For directions for making Bordeaux Mixture one is referred to p. 358 where mention is made of one per cent. Bordeaux as the strength generally used and that so far as is known this can be applied without injury to the trees which includes, presumably the leaves since it is also recommended as a measure against leaf diseases. It is difficult to understand why one per cent. Bordeaux Mixture should kill lichens in a few days after spraying and at the same time not injure leaves. As a matter of fact one per cent. Bordeaux Mixture is not satisfactory against lichens. A stronger solution is effective as also is washing soda solution which is much cheaper, more easily prepared and has been known for many years. The illustrations are good.

H. R. B-J.

* * *

WEST INDIAN READERS, J. O. Cutteridge. Thomas Nelson and Sons Ltd., price 1s. 2d. pp. 99.

This book serves as a foundation for the work of Books I, II and III, which were reviewed in *Tropical Agriculture*, Volume IV, No. 9. One merely need add the fact that the very high standard then set has been well maintained.

C. Y. S.

BOOKS RECEIVED.

WE have to acknowledge receipt of the following books :—

AGRICULTURE.

The Banana. P. Keep Reynolds' pp. 182, *Houghton Mifflin & Co.*, 8s. 4d.

BOTANY.

The Useful and Ornamental Plants of Trinidad and Tobago. W. G. Freeman & R. O. Williams, pp. 198, *Department of Agriculture*, 2s. 6d.

Plant Respiration. Dr. S. Kostychev, pp. 164, *P. Blakistons Son & Co.*, 10s. 6d.

ECONOMICS.

A Primer of Agricultural Economics. Sir Henry Rew, pp. 230, *John Murray*, 5s.

An Economist's Protest. Edwin Cannan, pp. 438, *P. S. King & Son*, 16s.

Land Tenure and Agricultural Production in the Tropics. H. Martin Leake, pp. 140, *W. Heffer & Sons, Ltd.*, 7s. 6d.

The Laws of St. Vincent, Vols. 1 and 2, revised edition, 1926. Prepared by James Stanley Rae, pp. 1624, *Crown Agents for the Colonies.*

GENERAL.

The Ministry of Agriculture and Fisheries, Sir F. Floud, pp. 330, *G. Putnam's Sons, Ltd.* 7s. 6d.

Hunting Under the Microscope. Sir A. Shipley, pp. 184, *Ernest Benn, Ltd.*, 8s. 6d.

CHEMICAL NOTES.

Compiled by the College Department of Chemistry and Soil Science.

The Fate of Burnt lime in the Soil.

A further contribution towards the knowledge of the effect of burnt lime on the soil and the relative economics of single and of periodic addition of lime has been made by W. H. MacIntire (*Soil Sci.*, 24, 475, 1927). He has determined the loss of calcium and nitrogen by leaching, from four sets of tanks of a brown loam soil, limed to different extents, over a period of four years. Lime was applied in four different proportions; in one case to the top layer only, and in another case to the sub layer only. The loss of calcium from the soils receiving lime at the rate of 250 lb. per two million lb. of soil (representing one acre) was very little greater than the loss from a control soil receiving no lime. With soils receiving 1,000 lb. and 2,000 lb. the increased loss was almost entirely during the first year, and was much greater during that period from the plots treated in the sub soil than those treated in the top soil. In the third and fourth years, the loss from these plots fell almost to that from the control plot. Thus the ratio of calcium lost to calcium applied was much less from the plots with the smaller additions.

The calcium in the leachings from the plot receiving the lighter application was present chiefly as sulphate and nitrate, showing that some interaction with the soil constituents had occurred, while that contained in the leaching from the other plots was present chiefly as bicarbonate. Losses of nitrate and sulphate were dependent largely on the rainfall.

The evidence appeared to support the idea that frequent small additions of lime to an acid soil are more economical, from the point of view of soil improvement, than one larger addition. Although the amount of lime fixed by the soil is proportionately greater in the case of the lighter additions, it does not follow, however, that the total proportionate loss from four successive additions of 250 lb. would be less than the loss over the same period from one addition of 1,000 lb. The loss and the beneficial effect of the lime will be affected by the relative aging in each case.

* * *

Citric Acid Manufacture.

The economical production of pure citric acid is found to depend mainly upon the purity of the calcium citrate from which it is prepared. Impurities in the calcium citrate are largely caused by the presence of granules of free quick-lime in the slaked lime used in the neutralization of the juice. They cause the formation of resinous matter from the sugars present in the juice. The inclusion of these granules has been overcome by preliminary purification and careful slaking of the quick-lime. The slaking is carried out in three basins placed one above the other. Small quantities of water are added to quick-lime in the highest basin, causing it to disintegrate slowly. Excess water is added, and the supernatant sludge is run off into the second basin, leaving any coarse particles behind. The sludge is allowed to settle partially, and the lime remaining in suspension taken off into the third basin, where it is allowed to settle out. The supernatant liquid is pumped back for use in the first basin.

Coarse foreign matter in the juice is removed by heating the raw juice to about 90°C., when such impurities rise to the surface, and may be skimmed off. Any juice removed in the skimming is recovered by filtration. The juice is immediately half-neutralized by adding lime suspension in a thin stream. The temperature is then raised to 100°C. and the juice brought to the neutral point by the addition of more lime. The presence of colloidal matter in the juice causes the formation of small crystals, which are readily acted upon by sulphuric acid in making free acid. Clean, colourless solutions of citric acid from which pure crystals can be obtained are produced by this process.—(B. Mellis, *Gorn. chim. ind. applicata*, 9, 457, 1927, *Chem. Abs.* 22, 58, 1928.)

* * *

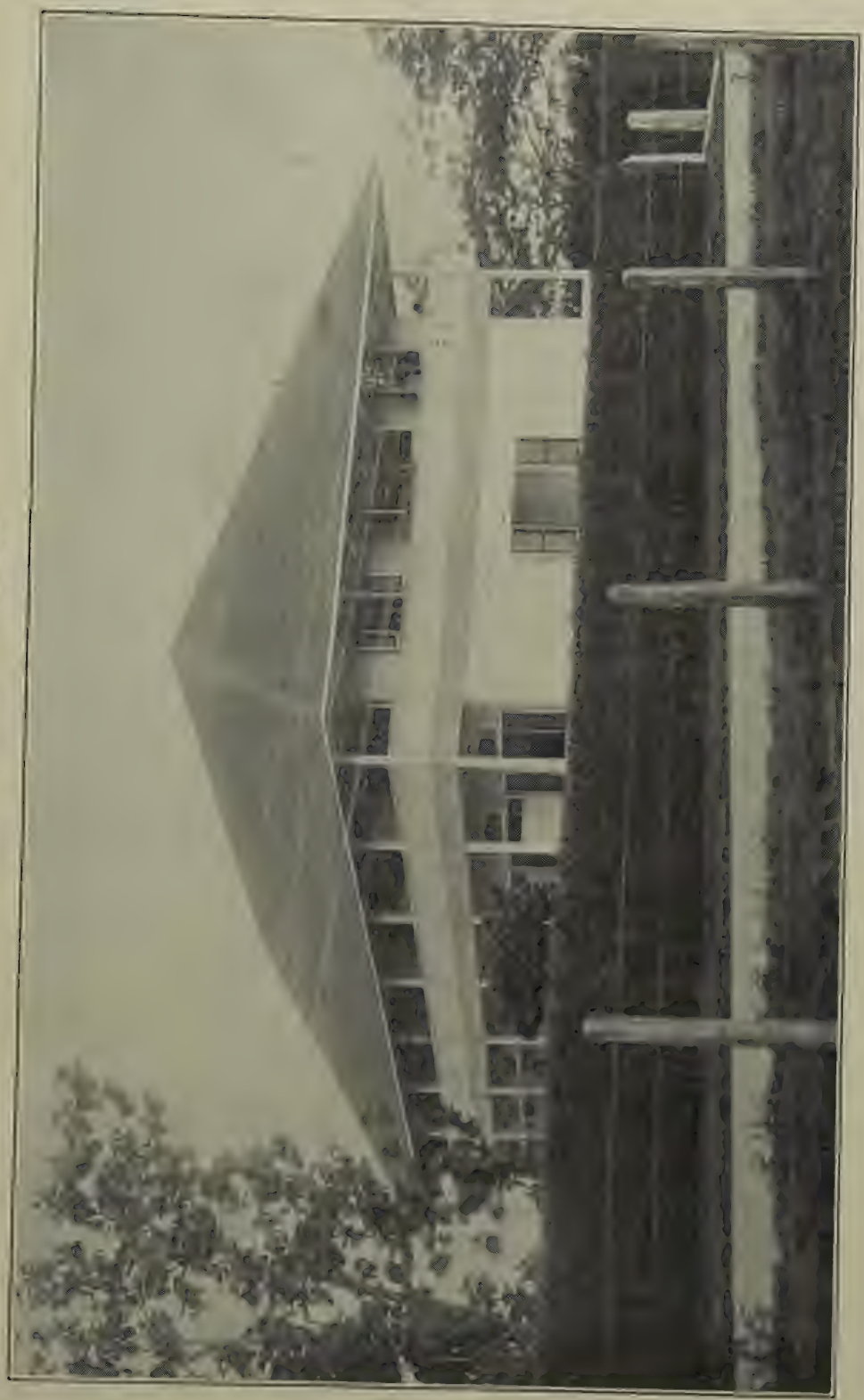
Eye-Spot Disease of Sugar-Cane.

Eye-spot is a minor leaf fungus disease causing a considerable loss in Hawaiian canes. Some varieties are inflicted sufficiently to start top rot of the cane stalk. A study has been made (Lee and Martin, *Ind. and Eng. Chem.*, 20, 220, 1928), of a supposed relationship between incidence of the disease and the type of plant food present in excess in the soil. Excess of artificially applied nitrogen was considered to increase the disease while excess potash curtailed it. From the investigation it was concluded that primarily, incidence of the disease depended on the moisture content of the soil and the atmosphere. The wet season and dewy nights were followed by the heaviest outbreaks of the disease, while it was practically negligible during the dry season. Normal applications of various fertilisers on some trial plots were insufficient to outweigh the effect of seasonal variations in moisture. Heavy applications, however, resulted in the disease becoming more prevalent on those plants treated with nitrogenous fertilisers, unchanged on the plants treated with phosphate and less prevalent on those plants treated with potash fertilisers. Growth response of the cane did not appear to influence the effect of the various fertilisers.

Nitrogenous fertilizers should therefore only be applied after the wet season when any effect due to them will be counteracted by the lowering of the humidity.

Analysis of the leaf ash and leaf saps from the various fertilised plants might give interesting information.

The Milner Hostel.



Photograph by L. Tucker.

The Hostel is described on page 127.

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Catalogues on Application.

SUGAR NOTES.

Compiled by the College Department of Sugar Technology.

Some Properties of Cane-wax Complex.

The properties of cane-wax are dealt with in a paper by C. F. Bardorf.—(*Can. Chem. Met.* 11, 231-4, 1927.)

The waxy material naturally occurring in sugar-cane persists throughout the raw-sugar factory and can be traced again throughout the refinery. It is adsorbed to a varying extent by filter cloth, paper pulp, kieselguhr, and especially by bone-char. Cane wax was determined in the rind of the cane and in the different products of the raw sugar factory, in the case of solid materials by direct extraction with hot acetone and hot alcohol, and in solutions by first trapping by means of Na_3PO_4, followed by extraction with the solvents named. Filter-press cake on a Cuban estate contained 21.16 per cent. of wax, and molasses may contain 2-3 per cent. The wax complex consists of at least 5 different constituents, 3 extracted by acetone, 1 by alc. and 1 by H_2O but the most important are an olive-green, soft wax, m. 52°, extracted by acetone, and a brown wax, m. 82° extracted by alcohol. The quantities of material extracted by acetone and alcohol from a number of raw-sugar factory products are shown in a table. The green wax can be heated to 460° without decomposition; it boils at 470-800°. The brown wax is a little less stable, and starts to decompose almost as soon as boiling begins at 450°. The green wax contains 6-7 per cent. of an oil which distils off at 280-300°. The waxes can easily be emulsified in water or sugar solution, by shaking at 40° or over, giving practically uncoloured emulsions. But the oil contained in the acetone extract gives a decidedly brown coloration, under the same conditions. The wax complexes are very resistant to H_2SO_4 and to strong NaOH solution in the cold. The soponification numbers of both complexes are very high, varying from 168 to as much as 860, depending on their source. Further studies are promised.—(*Sugar*, Vol. XXX, Nr. 2, p. 72.)

* * *

Soil Acidity and Sugar-cane Growth.

A recent issue of the *Java Archief* (1927, 6, pp. 207-228), presents a very interesting account by Dr. O. Arrhenius of the relationship between soil reaction and sugar-cane growth in Java. The cane-growing districts of that island were surveyed, and determinations of reactions values (pH values) of the soil samples obtained were made by the Gillespie colourimetric method. The results were plotted on a series of field maps. They show that the soils of Eastern Java are much more alkaline than those of Western Java. This difference in soil reaction is ascribed to differences in rainfall between these two regions. Western Java has a humid climate, whilst Eastern Java is semi-arid. The soils of Western Java are highly leached.

Very few liming experiments have so far been carried out in Java. Out of twenty reliable experiments, only five showed increased returns following liming. The soil in each of these five cases, however, was acidic in reaction before lime was applied. Here, liming gave an average increase in yield of sugar-cane of some 15 per cent.

In general, sugar factories situated in the acid lands (pH less than 6.4) show a lower output than those situated on alkaline lands in Java.

Besides leading to increased soil acidity, leaching by rain water has lowered the contents of nutrient elements in the soils of Western Java. Thus a close correlation between phosphate content and degree of acidity was discovered for the Javan soils. Nearly all the soils of reaction values below pH 6.0 showed phosphate deficiency.

Determinations of soil reaction values are of great practical value in laying out new lands for sugar-cane cultivation. In Java, it is considered uneconomic to correct soil acidity by liming. Consequently, it is recommended that only these new lands that are naturally alkaline or neutral in reaction be brought into cane cultivation.

* * *

Revolving Knives and Shredders.

A paper on this subject by Dr. F. Maxwell (*Facts About Sugar*, Vol. XXIII, 4, p. 90) may be summarised as follows:

(1) Where cane is mechanically unloaded on to the carrier, knives and shredders are used in supplementary combination. They work together in useful harmony and do not compete against one another for an exclusive place in the milling plant. Knives are primarily used for levelling and feeding purposes, and shredders for disintegration and preparation proper of the cane. Under normal conditions the use of knives increases the capacity of a milling train by about 10 per cent. while the use of a modern shredder increases the aggregate extraction of the milling train by 1½ to 2 per cent.

(2) Either one or two sets of knives may be used, but to avoid the wastage of motive power, the knives should be used for levelling purposes only.

(3) A shredder of modern type is essential to achieve economically the maximum extraction by the milling plant.

(4) Where cane is loaded on the carrier in regular layers by hand, the advantages gained from levelling by knives are not balanced by the gain in capacity.

The Humber Fishing and Fish Manure Co., Ltd., have been awarded a Royal Warrant as Fertilizer manufacturers to H. M. the King.

COLLEGE NEWS.

The College Sugar Factory commenced its season on 15th March.

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Professor Ballou, Commissioner of Agriculture returned from an official visit to St. Lucia on 9th March.

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Mr. Hobart Phillips, of Barbados, arrived at the College on the 24th March to take a course in Sugar Technology.

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The foundations of the new Chemical Block were laid on 15th February and work has also begun on the foundations of the Low Temperature Station.

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We welcome back Professor Hardy who returned to take up his duties on 19th March, and congratulate him on his rapid recovery from a serious illness.

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AT a meeting of the Trinidad Science Club on 22nd March, Professor Ballou, M.SC., Commissioner of Agriculture for the West Indies, gave a lecture on "The Imperial Department of Agriculture."

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Mr. P. Longley, a member of the staff of the British Suchar Process, Ltd., arrived on 28th March at the College where he will spend a few days conducting syrup and white sugar trials with Suchar.

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Mr. C. S. Orwin, M.A., and Professor Ernest Shearer, M.A., B.SC., have been nominated by the Universities of Oxford and Edinburgh, respectively as their representatives on the Governing Body of the College.

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Dr. E. A. Seagar, Professor of Tropical Sanitation and Hygiene who is going home on leave, and Mrs. Seagar sailed in the s.s. *Bayano* on 20th March. Mrs. Briton-Jones, wife of the Professor of Mycology sailed by the same boat.

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The College is again much indebted to the Cane Farming Department of the Usine Ste. Madeleine for their gift of two levelling shovels, which will be most useful for levelling up the fields and avoiding the low places which interfere at present with cultivation.

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Among recent visitors to the College were the Earl of Ypres, Mr. F. Wooton Isaacson, Vice-Admiral H. R. Crooke, C.B., and Mrs. Crooke, Captain C. A. W. Wrightson, C.B.E., R.N., Mr. P. Wise, son of Sir Frederick Wise, M.P., and Mr. and Mrs. H. W. C. Carr-Gomm.

A party consisting of the Principal, Professors Wood and Cheesman, Mr. Baker, and sixteen Colonial Office, and six Empire Cotton Growing Corporation students sailed for British Guiana on the s.s. *Cottica* on 25th March and arrived at Georgetown on 27th March. They returned to Trinidad by the s.s. *Inanda* on Sunday, 1st April,

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A most welcome gift has recently been received in the shape of a selection of ploughs and a single row planter from the well-known firm of Messrs. Ransomes, Sims and Jefferies Ltd., of Oswell, Ipswich. These implements will be used for demonstration purposes and for actual work that is to be done on the College estate. Of the ploughs three can be attached by a long pole direct to the yoke of a pair of oxen and one is the old long breasted "English" plough which is expected to do excellent work sod ploughing on the savannah that is being reclaimed. The single row planter can be fitted at any and every distance for sowing cotton, maize, and beans. These valuable gifts have been much appreciated and our thanks are due to the firm for their generosity.

AGRICULTURAL EXCURSIONS.

ON Saturday, 3rd March, an agricultural excursion organised by the Department of Economics, was made to the estates and factory of the Ste. Madeleine Sugar Company. The party of twenty-six students was accompanied by the Principal, Professors Shephard and Wood and Messrs. Baker, Gianetti, Hurst, Loumeau and Wright. At Harmony Hall Estate the party saw a covered stack of megass bales and discussed, with the officers of the Company, the problem of the profitable disposal of factory megass surplus to its fuel requirements, and the possibility of converting the factory to oil-burning and disposing the whole supply of megass in this way. Having inspected herds of young and working bison, a visit was made to fields being chiselled and ploughed by tractor-drawn implements. Two tractors the 4 and 5 ton Holt models which are capable of drawing ploughs set at a depth of between 15 inches and 18 inches were seen at work. The party then inspected some sugar-cane plots on which liming experiments were being carried out to cope with the froghopper pest. Mr. Jones, Agronomist to the Company stated that as much as 15 tons of lime had been applied per acre and that the yields of cane varied on the plots treated from between 47 to 55 tons an acre. Two species of cane, the Uba and Palmer Seedling were pointed out to the party; while the first forms ratoons and does not trash easily, the second which is grown extensively in India trashes easily but does not form any ratoons. Other things of interest seen on the estate before lunch were a baling machine, a hay lifter and a road grader.

At lunch, Mr. Skinner, General Manager of the Ste. Madeleine Company, and a Governor of the College, welcomed the party on its fourth annual visit, and referred to the benefits resulting from the co-operation between the Company and the College. Mr. George Moody-Stuart, Chairman of the Company, and Chairman of the Finance Committee of the College, gave an interesting account of the manner in which the area now controlled by the Ste. Madeleine Sugar Company had modified its economic organisation in response to changing conditions of sugar production. He congratulated the students upon their choice of careers.

The visit concluded with an inspection of the factory and the home farm which is equipped with a model dairy and has a fine herd of pedigree Friesian cows. Mr. Skinner gave a most interesting lecture on the system of accountancy adopted by the Company and with the help of typed forms and diagrams explained the organisation which had been set up to collect the necessary data from the estate, transport, and factory departments.

The College is deeply grateful to the staff of the Company for a most instructive and enjoyable day, and to Mrs. Skinner, and the other ladies present, for their very generous hospitality.

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A second visit to the Caroni Estate was paid on Wednesday 14th March by a senior class of students accompanied by the Principal, Professor Wood and Mr. Baker. After the party had inspected the work of a Fowler double engine set equipped with a ploughing tackle it was given the opportunity of observing the methods of harvesting cane from the time of cutting to that of loading into trucks for conveyance to the Mill. The party then proceeded to the Estate Sugar Mill where the chief Chemist, Mr. Hinchy, before showing it round the works explained the two methods by which sugar was being extracted, one being by diffusion after light crushing and the other by the usual method of crushing in an eleven roll mill. Our thanks are due to Mr. Arbuckle, Mr. Grant and Mr. Hinchy for a most profitable and enjoyable visit.

The following appointments have been made by the Secretary of State for the Colonies during the month of February, 1928:—

Mr. C. B. C. Handley, B.SC., Assistant Agricultural Officer, Kenya Colony.

Mr. R. E. Moreau, Secretary and Librarian, Amani Institute, Tanganyika Territory.

Mr. H. Marsland, B.SC., Cotton Investigator, Agricultural Department, Tanganyika Territory.

Mr. A. J. Seex, Staff Surveyor, Tanganyika Territory.

Mr. P. J. Greenway, Systematic Botanist, Amani Institute, Tanganyika Territory.

OBITUARY.

C. C. GOWDEY, B.SC.
Government Entomologist, Jamaica.

WE learn with regret from the public press of the death of Mr. Carlton Craig Gowdey, at Jamaica after an illness of short duration. Mr. Gowdey, a native of Barbados, was educated at Harrison College in that Colony and the Massachusetts Agricultural College, where he received the degree of B.SC. in 1908. After a short term of service with the Gypsy and Browntail Moth Commission in Massachusetts, and with the Imperial Department of Agriculture in Barbados, Mr. Gowdey was appointed Government Entomologist, Uganda, in which position he served from 1908 to 1920, when he was appointed to the position in Jamaica, which he held at the time of his death.

An energetic worker and an enthusiastic Entomologist, Mr. Gowdey's record in Government Service is an excellent one. He was a representative of the Jamaica Government at the hearing at Washington in 1921 on the Quarantine of Jamaica Fruits in the United States of America, and in 1923 and 1926 visited Colombia for the United Fruit Company to investigate the outbreak of the Fruit Scarring Beetle in that country, and to make recommendations for its control. The control measures recommended in his reports are stated to have been highly successful. His published papers include *Aleyrodidae of the West Indies, Insect Pests of Crops in Jamaica* and papers and articles on Agricultural Entomology, and he added very considerably to the insect collections forwarded from Uganda and Jamaica.

THE MILNER HOSTEL.

A PHOTOGRAPH of the Milner Hostel will be found on page xi. The Hostel, like the College Dining Hall, was designed by Mr. C. T. Watts, Engineer and Technical Assistant to the College, and was built at a cost of £4,433. It is a two-storied reinforced concrete building with a centre passage on each floor separating sets of eight bed sitting rooms, there being altogether thirty-two rooms. The building was begun early in February last year and completed at the end of September.

WE learn that a prize of one hundred contos or approximately $1,200 is being offered by the State of Rio de Janeiro for the best thesis presented on the subject of "The etiology and treatment of mosaics of sugar-cane." The competition is open to students and scientific workers of all nationalities. The thesis should be handed in before 31st December, 1928, and all additional information may be obtained from Dr. Eurico Teixeira Leite, Director, Instituto de Fomento e Economia Agricola, Rua Visconde de Sepetiba 337 Nitcheroy, E. de Rio de Janeiro, Brazil.

TREND OF THE MARKETS.

[*The notes below are based principally upon running charts of the prices of the basic grades and upon general statistical information gleaned from contemporary publications and cablegrams and are intended to be a record of movements. An attempt is made, where possible, to indicate the market outlook at the time of going to press, but no responsibility for the accuracy and subsequent truth of such observations is assumed. Unless otherwise stated the prices quoted are spot, London.*]

SUGAR.—At the beginning of March only a moderate business was done in raws in London, due principally to the comparative scarcity of offerings for forward shipment. Prices for Foreign 96° ranged from 12*s.* 1½*d.* (1st Mar.) to 13*s.* 4½*d.* (31st Mar.) *c.i.f.* per cwt., and for Preferential 15*s.* 10½*d.* (1st Mar.) to 17*s.* 1½*d.* (31st Mar.).

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COCOA.—The market is slow but Accra tends to be dearer. Prices during March were: Trinidad L.L.T. per cwt., 75*s.* to 80*s.* (1st March), 73*s.* to 80*s.* (31st March); Grenada L.L.T. per cwt., 72*s.* 6*d.* (1st March) 72*s.* to 73*s.* (31st March).

COTTON.—Business has been moderate and there has been an absence of outstanding features. In Sea Island, St. Vincent is attempting to develop a new market in the United States.

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RUBBER.—On 13th March, the price for plantation sheet was 11*d.* per lb., but there was a recovery to 1*s.* 1⅛*d.* by the end of the month. The market is regarded as bad and the motor interests continue to manage on a theoretically inadequate amount.

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COPRA.—More is doing both for England and for the Continent.

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COFFEE.—Brazil, Sumatra and India all report increased exports of coffee, while increased imports are reported by France, Germany, Italy, Egypt and Canada.

The Editor will be pleased to send a gratuitous specimen copy of *Tropical Agriculture*, post free, to anyone interested in tropical development.

COTTON PRICES, 1920-26.

THE following table of prices is of some interest. It gives the declared value, in pence per pound, of Empire-grown lint of under 1½ inches staple c.i.f. United Kingdom ports for the years 1920 to 1925 and from January to the end of August, 1926. For comparative purposes the declared values of lint under 1¼ inches staple from the United States and Portuguese East Africa are included. With the exception of Australia and perhaps the West Indies the cost of production is low and fairly constant, but the heavy "on-costs" place the lint outside the category of "bread-and-butter" cotton so far as the spinner is concerned.

Everything points to the conclusion that the great efforts made by the pioneers of the Empire cotton production can only be maintained by concentrating upon the growing of cotton which will command a large premium above the ordinary grades which form the bulk of total imports into this country, and that the supply of ordinary grades of American lint must, of necessity, be left to the growers of the United States and India. There are large areas of non-British land in Africa admirably suited in every way to the plantation system of cotton-growing, where cost of production is almost negligible, but the methods of obtaining and maintaining labour supply would not appeal to the people of this country.

Prices of Empire grown Lint under 1½ ins. staple, pence per. lb., c.i.f. United Kingdom Ports.

	1920.	1921.	1922.	1923.	1924.	1925.	1926.
Anglo-Egyptian Sudan ..	57.84	12.67	15.84	17.60	19.40	19.70	13.74
British West Indies ..	44.18	11.45	15.30	15.10	18.80	14.65	12.67
Australia	33.26	14.40	14.42	16.88	16.46	10.75	11.40
Uganda	36.41	11.73	14.00	16.21	18.70	16.41	12.53
Nyasaland	26.11	13.00	12.79	16.20	18.40	14.34	11.12
Nigeria	22.0	9.36	11.37	15.57	17.60	14.07	10.73
Natal	17.24	10.02	12.75	16.00	15.20	13.02	11.44
Other British Possessions..	25.56	18.00	11.57	14.24	15.50	15.23	13.30
British India	16.33	10.00	10.00	12.30	14.80	12.41	9.64
United States of America...	28.28	13.33	13.35	17.25	17.00	14.01	11.21
Portuguese East Africa ..	29.42	11.59	11.65	14.23	16.00	13.21	11.47

W. G. C.